REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	20 Oct 95	

4. TITLE AND SUBTITLE The Application of Geographic Information ~~System~~ System Technology To United States Air Force Enlisted Recruiting: An Ohio Example

5. FUNDING NUMBERS

6. AUTHOR(S)

Paul Anthony Cannizzo

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

AFIT Students Attending:

Ohio State University

8. PERFORMING ORGANIZATION REPORT NUMBER

95-126

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

DEPARTMENT OF THE AIR FORCE
AFIT/CI
2950 P STREET, BLDG 125
WRIGHT-PATTERSON AFB OH 45433-7765

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for Public Release IAW AFR 190-1
Distribution Unlimited
BRIAN D. Gauthier, MSgt, USAF
Chief Administration

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

14. SUBJECT TERMS

15. NUMBER OF PAGES 109

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT

THE APPLICATION OF GEOGRAPHIC INFORMATION SYSTEM TECHNOLOGY TO UNITED STATES AIR FORCE ENLISTED RECRUITING: AN OHIO EXAMPLE

A Thesis

Presented in Partial Fulfillment of the Requirements for

the degree Master of Arts in the

Graduate School of The Ohio State University

by

Paul Anthony Cannizzo, B.A.

* * * * *

The Ohio State University

1995

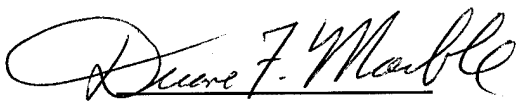
Master's Examination Committee:

Dr. Earl F. Epstein

Dr. Henry L. Hunker

Dr. Duane F. Marble

Approved by



Duane F. Marble
Department of Geography

To My Family

ACKNOWLEDGMENTS

Special thanks to Dr. Duane F. Marble for his guidance and encouragement throughout this endeavor. Also, many thanks to James Herries, Scott Digiacinto, members of Air Force ROTC Detachment 645, and all the members of Headquarters, Air Force Recruiting Service, Market Research Section, for their assistance, suggestions, and comments throughout the project.

To my wife, Marie-Louise, and my children, Jan, Jill, and Phillip, my sincerest thanks for the faith, understanding, encouragement, and love you have given me during the last two school years. Without you, this thesis would not be.

VITA

February 2, 1959	Born - Jersey City, New Jersey
1981	B.A., Jersey City State College, Jersey City, New Jersey
1982-1986	Instructor and Crewmember, KC-135, Ellsworth AFB, Rapid City, South Dakota
1986-1990	Instructor and Crewmember, FB-111, Pease AFB, New Hampshire
1990-1993	Evaluator, Instructor, and Crewmember, T-43, Mather AFB, California
1992-1993	Chief, Standardization and Evaluation, 323 Operations Group, Mather AFB, California
1993-Present	Active Duty Air Force Major assigned to the Department of Geography, The Ohio State University, Columbus, Ohio, as a Graduate Student

FIELDS OF STUDY

Major Field: Geography

Studies in Geographic Information Systems

TABLE OF CONTENTS

LIST OF TABLES

TABLE PAGE

LIST OF FIGURES

FIGURES PAGE

CHAPTER I

INTRODUCTION

In recent years, the United States military has been experiencing significant difficulties in recruiting enlisted personnel. These difficulties affect all the services and have resulted in the subject becoming a very high priority. In an attempt to alleviate this problem, the military is modernizing its recruiting structure and procedures, and appears to be willing to try new approaches and technologies that were before untried.

The focus of this paper will be upon a spatial analysis of the efforts of the United States Air Force (U.S.A.F.) to recruit enlisted personnel for its ranks, with the state of Ohio used as an example. The paper will briefly discuss why recruiting problems may exist, review current methods of recruiting being used, and the plans and goals of the U.S.A.F. Recruiting Service to increase accession rates. The main thrust of the paper will discuss how, and show examples of, the benefits of utilizing Geographical Information Systems (GIS) technology to enhance the recruiting process.

The Problem

The following statement by a former Secretary of Defense sums up the general problem the military faces in recruiting. Although it was written in 1980, it is clearly

applicable today. The only difference is that the numbers quoted have become even more bleak in light of current requirements.

> Seven years after I ended draft calls and as we enter the dangerous decade of the 1980's, the All-Volunteer Force is beset with severe and growing problems of both quantity and quality.
>
> Recruiting and retention targets have been revised downward each year. The Gates Commission was confident we could maintain a volunteer force of 2.5 million qualified people. When we ended the draft, the size of our force stood at 2.3 million, but we had confidence that this level or higher could be maintained. Today, it stands at about 2 million, 16 percent below the level of seven years ago. Each year, at least one of the services has missed these declining targets, and last year, for the first time, all four of our armed services failed to meet their recruiting goals. The Army fell almost 12 percent or 16,000 people below its target. Even the Air Force, normally in good shape in attracting high quality men and women to its enlisted ranks, missed its goal by 2,000 people. Overall the Department of Defense came in under its reduced recruitment goals by 25,000. (Laird, 1981)

Why This Problem Exists

Since the end of the draft and the implementation of the All-Volunteer Force in 1973, the military has had to compete with every business in the labor market, as well as colleges and universities, for its recruits. According to Gorman and Thomas (1991),

> The competition to hire and retain qualified employees remains a perpetual problem for employers in market economies. Although projected force reductions may provide a temporary respite for the American military, a smaller all-volunteer military will still have to recruit and retain qualified people in the face of stiff competition from the private sector. Even without budget cuts, future recruiting may become more difficult as the general decline in educational standards, in the size of the youth population, and in the proportion of those morally and medically qualified for service makes qualified recruits increasingly scarce.

In discussions with members of the Air Force Recruiting Service, located at Randolph Air Force Base, San Antonio, Texas, it became clear that recruiting efforts today are at an all time high due to the difficulty of enlisting qualified personnel. Current conditions contributing to the problem include:

1) The size of the 17-21 year old cohort, the Air Force's primary target for enlistment, is declining. Projected trends and analysis of census data show that the number in this group will continue to shrink until the mid-to-late 1990's, and this reflects a decline that began in the late 1970's (Gilroy, et al, 1990). According to Lockman (1987), "The major problem for manpower supply over the next decade will be recruiting and retaining enough career-oriented personnel in the face of the shrinking youth cohort. Productivity studies show that careerists are more cost-effective than first-term personnel."

2) Larger groups of high school graduates are going to college than ever before. Even though only 50 percent of those attending college will graduate, according to Air Force Recruiting Service, it is significantly harder to track down and enlist a "college drop-out". Many recruiters are now attempting to target colleges and universities, with the limited advertising budget at their disposal, to enlist these individuals before they leave school and enter the job market.

3) The funds available for recruiting advertisement have not changed for a number of years, and the little that there is is inadequate to do the job. Because of this, the Air Force does not purchase television time for advertisement. Any Air Force commercials viewed are presented as public service messages. The Air Force has been purchasing more radio time, but the majority of its exposure in this media area is still in the form of public service

messages. In an attempt to reach possible recruits with its limited budget, the Air Force produces its own film spots. These spots contain a "stay in school" message, but also show that the Air Force has the tools and opportunities one needs to get ahead, further ones dreams, help save money for advanced schooling, etc. These tapes are sent to recruits and school counselors to try to make the Air Force message heard.

4) As stated earlier, the Air Force focuses on the 17-21 year old group for enlistment. As such, recruiters spend quite a bit of time interacting with local high schools in their recruiting areas. The Air Force Delayed Enlistment Program pinpoints high school seniors, allowing them to join and select a career field in the service with the knowledge that this career field will be open to them for up to twelve months after enlistment. This allows the student to finish high school, take some time off after graduation to enjoy the summer, and then enter basic military training followed by work in their chosen career field.

The problem that arises is that access to high schools is becoming increasingly difficult to obtain. Many schools are stretched near their limits with their normal responsibilities, such as state testing, and find it difficult to make time for recruiters who wish to administer Air Force entrance and qualifying tests. Additionally, school counselors are steering more students toward college, 62 versus 53 percent in 1983, according to the Air Force Recruiting Service (Air Force Recruiting Service Unit Mission Briefing Guide, 1995). A possible reason for this is that counselors are being influenced by world events and the media, reacting to a perceived lack of job stability in the military.

5) Perceptions of the population based on media coverage are possibly the biggest problem with respect to recruitment. Extensive coverage of items such as early retirement,

reductions in forces, etc., provide the appearance of an unstable career environment, and other items, such as the ban on homosexuality, make the career appear discriminating. The most often asked question of recruiters is, "How can the Air Force be hiring when they are firing?" Recruiters say young people today believe that jargon such as downsizing basically means cutting jobs (Masko, 1995). The truth of the matter is that the Air Force has never lowered its recruiting goals, and still attempts to enlist 30-35,000 recruits a year. With Basic Military Training attrition rates so high and first enlistment term retention rates so low, the Air Force must continue to recruit at normal rates in order to function. The attrition and retention rates may be occurring as they are due to the fact that the Air Force is looking to retain the most qualified personnel, resulting in Basic Military Training and first enlistment terms being more disciplined.

6) The Air Force is also in competition with the other services, as well as with components of the civilian labor market, for its personnel which, as stated earlier, are coming from a smaller demographic cohort. According to the Air Force Recruiting Service, the Navy and Army are pursuing recruits by encouraging single-term enlistments, and have increased their respective college funds 200 and 100 percent to meet this goal. This allows these services to maintain recruit levels, and in reality, offer more money for college to the perspective recruit, but provide little chance of a military career. Since these services require more manpower than the Air Force, the jobs being offered, basic seamen duties ("swabbing decks") or infantry, are not the types of jobs the average person would enjoy doing for long or ones that the military would allow one to undertake on a career basis. The Air Force is

instead looking for the long-term, career oriented recruit, individuals that they feel will save money for the service in the long run.

Competition in the civilian labor market has also become more intense. Depending on where one lives, starting pay and benefits in the local economy can easily meet or exceed those received by a first term airmen. According to Segal (1981),

> Double-digit inflation, coupled with pay caps on civil-service and military compensation, has assured that the armed services are no longer in a competitively advantageous situation in the market place vis-a-vis civilian employers. Using data from the 1979 National Longitudinal Survey, Kim et al. (1980:71) show that when Regular Military Compensation is compared to average salaries and wages in the full-time employed civilian labor force, young males in the armed forces receive twelve percent less monthly pay than do their civilian counterparts.

Other areas where the military has problems competing with civilian employers concerns the fact that the military pay system is based on rank, and not the job being performed. All first term airmen make the same amount of money, whether they serve as mess hall cooks or aircraft maintenance technicians. The civilian labor market tends to base pay more upon occupational tasks, rather than upon age or experience. Finally, a military recruit is required to live and work in a more rigid environment that follows specific regulations and guidelines, personal as well as career. Additionally, there is the understanding that work continues until the job is completed, without the benefits of overtime allowances, etc. The civilian labor market, in contrast, has fewer defined personal regulations and, in the majority of cases, monetary compensation is offered for work conducted after the normal "quitting" time.

Air Force Recruiting Structure

To understand why the above factors impact Air Force recruiting, it is necessary to have a basic understanding of how the Air Force recruits and the constraints it must work under. The information that follows comes from the Air Force Recruiting Service mission briefing and an interview with the Columbus, Ohio recruiting flight commander.

Air Force recruiters cover the 50 United States, Europe, the Pacific, and Puerto Rico (most overseas positions are to recruit dependents of current servicemen). As of 17 June 1995, there were 206 officers, 2429 enlisted, and 296 civilian personnel working on Air Force recruiting issues worldwide. These personnel are assigned to recruiting flights. These flights make up 29 recruiting squadrons, which in turn, report to 4 recruiting groups (Figure 1). The recruiting groups report to Headquarters Recruiting Service, which is part of the Air Education and Training Command, located at Randolph Air Force Base, San Antonio, Texas. These personnel staff 922 full time recruiting offices, 654 of which are one-person offices, and can cover areas ranging from 7 to 64,000 square miles. The average recruiter is 180 miles from his/her squadron commander, 60 miles from his/her immediate supervisor, and 95 miles from the nearest military facility. The recruiter covers an area (or zone) of 1900 square miles, which on the average contains 19 high schools, one television station, and 9 radio stations. Due to budget and personnel constraints previously mentioned, there is one Air Force recruiter for every 2.5 Marine, 3.3 Navy, and 4.7 Army recruiters in a zone (Figure 2).

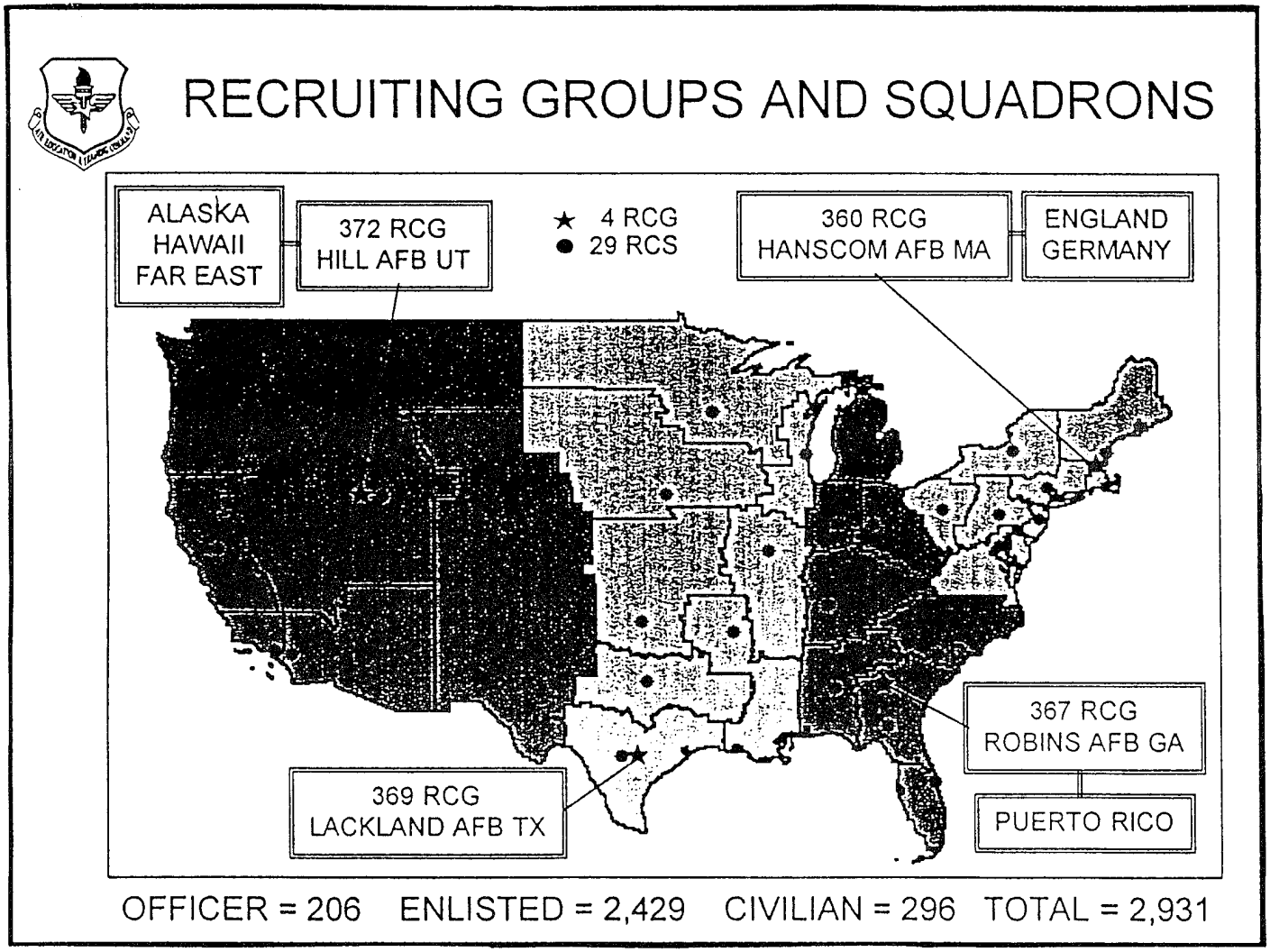


Figure 1. USAF Recruiting Groups and Squadrons

THE RECRUITING ENVIRONMENT

- COVERAGE: 50 STATES, EUROPE, PACIFIC, PUERTO RICO
- 922 FULL TIME RECRUITING OFFICES (654 1-PERSON)
- RECRUITING ZONES: 7 TO 64,000 SQUARE MILES

MEDIAN AF RECRUITER STATISTICS

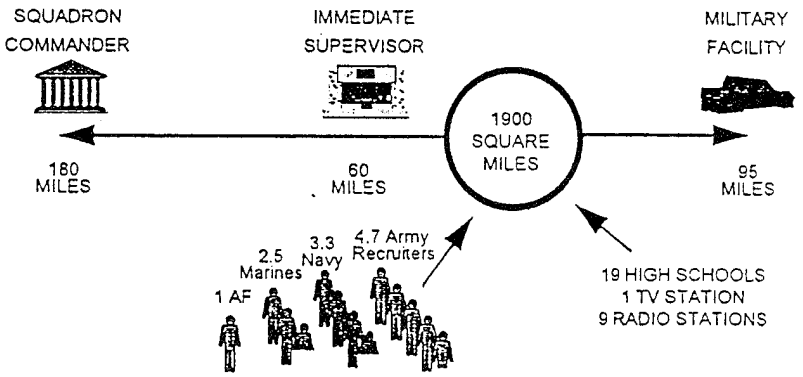


Figure 2. USAF Recruiting Environment

Job of the Individual Recruiter

An Air Force recruiters job, in a nutshell, is to stimulate interest in the United States Air Force and help those who desire to join to complete the entrance process. For a person to enlist, they must meet minimum physical, mental, and moral criteria. These criteria are evaluated at Military Entrance Processing Stations (MEPS), and not by the individual recruiters. The recruiters will visit high schools, college campuses, Independence Day celebrations, shopping centers, etc. to visibly show the Air Force uniform. At these meetings they answer questions and help potential recruits select a career and complete entrance requirements. Recruiters also receive lists of high school seniors for their respective zone and will make phone calls and conduct interviews in an attempt to spark interest in joining the service. To accomplish these tasks, many recruiters work 12 hour days, 6 days a week.

Air Force Recruiting Service

The mission of the Air Force Recruiting Service is to "Recruit a high quality volunteer force responsive to Air Force needs." The primary goal of Air Force Recruiting is to send the right number of people with the right job qualifications to basic military training (BMT) at the right time to meet Air Force needs. The right number are the specific monthly accession goals, and are further broken down into specific jobs or job areas with qualifications that the person filling that job must meet. They also must get to BMT at the right time to match up with the proper technical training class after graduation. Sending the right person at the wrong time can cause missed training seats or airmen in casual status waiting for the right course to start, both of which increase costs to the Air Force.

Other targets are important as well. These include a minimum Air Force Qualifying Test (AFQT) score of 40, no more than 3 percent non-High School Diploma Graduates, at least 50 percent in Test Score Category I or II (65 or more on the AFQT), and others. A new target recently added was to enlist at least 12.4 percent African-Americans and 6.2 percent Hispanics, per year, of the approximate 35,000 recruits required annually.

The Air Force Recruiting Service conducts a wide variety of studies to evaluate markets, set unit goals, evaluate performance against goals, track quality of recruits, determine effects or potential effects of recruiting policies, evaluate success of recruits at BMT, and others. Recently, specific studies for individual units have been carried out to try to find reasons for recruiting difficulties.

The assessment of performance begins with the setting of unit goals, which in turn begins by the Air Force Recruiting Service breaking out the overall goal set by Headquarters United States Air Force for each Recruiting Group based on market, number of assigned recruiters, and past performance. The Groups are then provided suggested Recruiting Squadron goals. Squadrons break the goals down to the flight level, where they are, in turn, broken down to the individual recruiter. Performance against these goals is the primary measure of success for the units and recruiters.

The Goal of the Research

The difficulty in obtaining recruits is a very real problem for the Air Force, since it can not function without them. For the Air Force Recruiting Service, the problem translates into the fact that they must compete with a variety of other institutions for their recruits, they have

certain goals with respect to quality and diversity, and they must track recruits and the potential population of enlistees. As stated earlier, the Air Force Recruiting Service attempts to accomplish these functions through the use of market analysis, based upon statistical applications such as regressions, to try to predict future availability, and advertising. One tool that has yet to be tried is geographic analysis. At present, the only role geography plays in recruiting is in the establishment of geographical boundaries for the squadrons and flights of a recruiting group. No geographic analysis of the origin of recruits has been undertaken. Presently, the Air Force Recruiting Service is trying to implement such a program through a PC-based system employing MapInfo. Unfortunately, they have had little success with getting the system working. At last report, they were still trying to get the system to draw recruiting flight, squadron, and group boundaries.

The goal of this thesis is to utilize geographic information system (GIS) technology in an attempt to examine the spatial patterns of Air Force enlisted recruiting within the state of Ohio. This will hopefully provide new insights into the areas of origin of present recruits as well as identifying those areas most likely to serve as sources of future recruits. Finally, traditional statistical analysis will be utilized in an attempt to predict the significant geographic factors involved in the enlistment decision, and to see if these factors display any specific geographical pattern in Ohio.

The next chapter will look at some of the literature and studies that have been published on recruiting enlisted members into the military. Unfortunately, it will not be a formal literature review because there has been little research, and hence, there is no real literature, on the subject. Following this review, there will be discussions about the data and

methods used in the empirical analysis, geographic products representing the data, some standard statistical analysis, and finally, conclusions and some suggestions on where this kind of study could progress.

CHAPTER II

PREVIOUS STUDIES OF MILITARY MANPOWER

An integral aspect of trying to find ways to increase the accession rate of recruits is to try to understand why people join the Air Force. Logically, if we can understand why the majority of those who have already enlisted have joined, then we can find those areas with similar socio-economic characteristics and focus our attempts to recruit upon those areas. Unfortunately, very little research has been done on the subject of what motivates an individual to join the military, and in this particular instance, the United States Air Force. A careful review of the geographic literature, such as the *Professional Geographer*, the *Annals of the Association of American Geographers*, etc., for the last two decades reveals that this problem has yet to be addressed by the geographic community. Those studies that have been undertaken by non-geographers mainly fall into three categories: manpower studies, determinants of enlistment, and surveys.

Manpower Studies

Since the end of the draft and subsequent advent of the all-volunteer force in 1973, most research on military enlistment has concerned itself with predicting the number of recruits the services will need through numerous manpower studies. These studies, conducted individually by each service and collectively by the Department of Defense, try to

accurately depict the strengths and shortfalls of the number of servicemen projected over a period of time. Based on these studies, the headquarters of each of the services sets enlistment goals for the coming year. This puts into motion the recruiting procedures previously discussed.

Determinants of Enlistment

As stated earlier, little work has been done on what motivates someone to join the armed services. Most of the research that was conducted on this subject is 10-15 years old and is now outdated due to changes in the economy and the smaller youth cohort from which to enlist. According to Kim (1982),

> The primary source of military manpower is the youth labor market. The seemingly successful operation of the all-volunteer force system during the 1970s appears in retrospect to have been due to the entrance of the baby boom cohort into the labor market, which created an oversupply of young workers, and to the much deteriorated youth labor market conditions during that period, possibly also a consequence of the overcrowding phenomenon. Because the currently shrinking youth population is expected to adversely affect recruitment and retention efforts, understanding the characteristics of the individuals who have participated or intend to enlist in the armed forces is essential to establishing appropriate military manpower policies.

That observation, made in 1982, is true for the present. The economy has improved and civilian jobs pay better, more youth are attending college, and there are many job opportunities available for someone wanting to work.

A study was undertaken for the United States Army in 1984 by Dale and Gilroy to study determinants of enlistment over a 6 year period from October 1975 to March 1982.

Their findings follow:

1) As the national unemployment rate rose, so did the number of Army enlistments. Additionally, if the unemployment rate were to drop 1 percent, it was calculated that Army enlistments would decrease 8.8 percent. In their study, Dale and Gilroy perceived a direct relationship between the unemployment rate and enlistment rate.

2) If the national economy were to show any significant signs of recovery, enlistment rates would fall unless the Army instituted an equivalent pay increase.

3) Educational benefits are very important to many enlistees and the establishment of special types of educational benefit programs may encourage more high school graduates to enlist.

4) There are other, non-economic, factors that may also play significant roles in why individuals enlist.

Surveys

The study just mentioned was done for the Army. No equivalent studies were found to be done for the Air Force. The closest type of studies that are done are the Air Force Recruiting Service Basic Military Training Surveys. These surveys are distributed to a proportion of enlistees about the 28th day of the 30 day basic military training course. The following information has been extracted from the 1993 Basic Military Training Survey Report (Air Force Recruiting Service, 1993).

The Basic Military Training survey program began in late 1976 with four basic objectives:

a) determine trainee perceptions of the recruitment process,

b) evaluate the impact of advertising on enlistment decisions,

c) gather data on the impact of various recruitment policies and procedures,

d) establish a comparative data base to track trends over time.

The most frequently selected reasons for joining the Air Force are: "To continue education", "To get a secure job", "To serve country", "To gain job experience for civilian employment", and "To be trained in a skill". "To continue education" has been the number one reason for joining the Air Force since fiscal year 1986. Approximately one-fourth of those surveyed selected the Air Force over other services because they viewed the Air Force as "the most prestigious service". Over three-quarters of the respondents would have either gone to college full-time or attended a vocational/technical school if they had not joined the Air Force, and less than one-fifth of the respondents would have joined another service.

Overall, 44 percent of the respondents indicated that the state of the economy had a strong or moderate influence on their decision to join the Air Force. Comparing race/ethnic groups, almost 60 percent of those classed as Orientals responded that the state of the economy had a strong to moderate influence. The responses of the other groups were more in line with those of the overall group. The majority of respondents discussed joining the Air Force with family members and were encouraged by them to join. Parents had the greatest influence upon the decision to join and were generally the most positive influence with respect to the Air Force.

Geographic Analysis and Recruiting

From the survey, one can come to some conclusions as to why an individual enlists in the Air Force. Unfortunately, many of the reasons cited such as "To serve country" or "To get a secure job", etc. are hard to quantify, measure, and ultimately predict when viewing a cohort for possible recruiting. One can not look at a specific high school or county and determine that the attitude "To serve country" is higher there than somewhere else. But, if quantifiable determinants could be found, such as unemployment rate, education level, etc., and a pattern discovered, one could then target that area for enlistment. Most of the studies employed some type of regression analysis or survey sampling, but had no explicit spatial component.

None of the studies conducted for the United States military were found to have any significant geographical component attached to them. However, one study conducted by the British military did address geographic issues. According to the authors, Dandeker and Strachan (1993),

> ...spatial analysis research could produce detailed information on the social characteristics of the army's target populations for recruitment; the social/geographical settings in which they are located; and the ways in which these patterns cluster with other variables, especially those facilities/activities that are under the control of the army or subject to its influence. It would then be possible to indicate where recruitment resource inputs would be most likely to produce a reasonable return, and to test the reliability of these indicators by analyzing subsequent recruitment data.

In the following chapter, the data used to conduct the empirical analysis for this thesis will be discussed. This discussion will include where the data came from, problems

encountered with the acquired data, the measures taken to fix those problems, and the condition the data was in as the analysis progressed to the next step.

CHAPTER III

DATA ACQUISITION AND MANIPULATION

The conclusions of any empirical analysis are dependent upon the quality of the data used in conducting the analysis. Researchers need to have an understanding of where the data came from and how it was manipulated to effectively capitalize upon its potential. This chapter presents an overview of the data used in this project. The areas to be covered include how and where the data was obtained, problems encountered with the data and the processes used to fix those problems, and the condition and format the data was in when it was used for analysis.

Data Acquisition

Data for this project was acquired from three separate sources for input into ArcView 2, the geographic information system being employed. The data that was obtained included geographic boundary files, demographic data, and Air Force enlisted recruiting data tabulated for the state of Ohio at both the county and census tract levels.

Geographic Boundary Files

Geographic boundary files for the state of Ohio for counties, census tracts, and cities were obtained from the Public Utilities Commission of Ohio (PUCO). These files were in very good condition, presented a proper and believable spatial picture of the state of Ohio, and were readily accepted by ArcView 2 for mapping purposes. These files contained county names and associated county identification codes (FIPs), census tract identification numbers, city names, and some additional descriptive information such as area size and the like. No additional work or manipulations were required to be performed on these files other than loading them into ArcView 2.

Demographic Data Files

Demographic data at the county and census tract levels were obtained from compact discs marketed as *First Street*, produced by Wessex, of Illinois, a retail data acquisition and aggregating company. The version of First Street used reflects data obtained from the 1990 census. Desired fields of data were simply selected, downloaded, and saved as database (.dbf) files at both the county and census tract level. These database files were then brought into the Statistical Package for the Social Sciences (SPSS), a commonly used statistical analysis computer program package. SPSS allowed these files to be merged with the recruiting data files to form one large database. Additionally, SPSS was used for all statistical analysis performed on the data. After the statistical analysis was complete, SPSS allowed the data to be saved as a database file that could be used by ArcView 2. In addition to the demographic data described above, road network files for the interstates in Ohio were also obtained from

First Street. These files would be used to enhance the ability to identify features and areas within the state.

Air Force Enlisted Recruiting Data Files

Air Force enlisted recruiting data files were obtained from the Headquarters Air Force Recruiting Service, Market Research Section, located at Randolph Air Force Base, San Antonio, Texas. Data on all persons who expressed an interest in joining the Air Force and accomplished entrance testing, for fiscal year 1993 through the first quarter of fiscal year 1995 (a fiscal year runs from 1 October of the year prior to 30 September of the year being defined) were obtained. The data consisted of 15,604 records, each with 15 variables on each potential enlistee. The data was received in American Standard Code for Information Interchange (ASCII) comma delimited format. When reviewed, this data was discovered to contain a number of errors, and was eventually moved into a number of different software programs for clean-up, transformation, and aggregation. Before discussing this process, a simple and quick review of all the data obtained for this study follows.

Air Force and Other Empirical Data

The following list shows the data obtained from each source, and where appropriate, a definition for the variable. As stated previously, all data are for the state of Ohio.

Boundary Files from PUCO:

County boundaries
Census Tract boundaries
City boundaries

Demographic Data from First Street: (Data was downloaded at the county and census tract level for each variable)

County Identification codes
Census Tract Identification codes
Per capita income
Percent unemployment
Number of persons with a high school degree
Total number of persons
Population density
Total number of 17-21 year olds
Number of White 17-21 year olds
Number of Black 17-21 year olds
Number of Asian 17-21 year olds
Number of Hispanic 17-21 year olds

Air Force Enlisted Recruiting Data: (for each individual record)

Status Code - a notation used to identify an individuals enlistment status at a Military Entrance Processing Station. Status codes will change as an individuals status changes.

Processing Date - date recorded for an individual as that individual changed status.

Air Force Qualifying Test score - a vocational aptitude battery test, similar to the Scholastic Aptitude Test (SAT), requiring a minimum score of 40 to be eligible for enlistment.

Race
Ethnic Group
Sex
Citizenship
Marital status
Number of Dependents
Highest education level attained.
Date of Birth
Street Address
City
State
Zip code

Data Errors and Problems

As previously stated, the geographic boundary files and demographic data files required little manipulation other than loading into the appropriate software program. There were basically no problems with the data, and any manipulations that were done to them will be discussed later in this chapter. The Air Force enlisted recruiting data, on the other hand, fell at the other end of the "useable" spectrum, and required a number of hours of clean-up to be functional. Following are the problems that were encountered and the methods used to fix these problems. Manipulations to the corrected data will be discussed later in this chapter.

Format Problems

One of the first problems noted with the recruiting data was that of format. The data was received in an ASCII comma delimited format and many of the commas separating the fields were duplicated. This problem forced the software system to believe a data field existed between the commas when, in reality, none actually did. The easiest method found to delete the double commas was to bring the file into Foxpro, a PC-based database management system, and use its search and edit function to find all the double commas and replace them with a single comma.

The next format problem noted was that many of the records had double processing dates when only one should have existed. Approximately ten percent of the records contained this error. This variable should normally have had a field size of six digits, representing year-month-day (yymmdd). This error showed up as a field size of eight digits, a comma, and a

field size of four digits, representing "yymmddyy,mmdd". Additionally, no comma existed after the field of four digits separating it from the next variable which was either "M" or "F", representing the gender of the individual in the record. Foxpro was again used to insert a comma between the unwanted field of four digits and the gender variable. Then, the search and replace function was used to find and delete the unwanted field of four digits. Finally, the same function was used to find all the fields of eight digits, delete the last two digits to truncate the field to six digits, and insert a comma to separate it from the next variable.

The third format problem found was that there was no comma separating the Air Force Qualifying Test (AFQT) score from the beginning of the street address field. A couple of steps needed to be taken to fix this error. Using Foxpro, a comma was placed two digits into the combined field of AFQT score and street address, making all the AFQT scores two digits. This was done because the record layout of the fields received from the Air Force Recruiting Service showed this variable to have a field size of two digits. This meant that no individual scored one hundred percent on the test, and therefore, all test scores had to be ninety-nine or less. Since the record layout showed a field size of two digits, it was also concluded that anyone scoring less then ten on the test would have a zero placed in front of their score to maintain a field size of two digits. Although this process gave every record an AFQT score, it left some records without a residence number in the street address field. This meant that it was impossible to determine if the street address did not contain a residence number, or if a test score was actually never reported. After careful consideration of the situation, the decision to maintain a test score for each individual, and not have a residence

number for some, was considered acceptable since only about one hundred and fifty records, or approximately one percent of the total records, were affected in this manner.

The final format problem dealt with the zip code field. All the zip codes were reported as nine digits, with the last four digits being all zeros. Since the zeros in the field did not contribute to more precisely identifying the location of the record, the last four digits of the field were deleted. This was done using Foxpro, and resulted in a five digit field containing the zip code variable.

Spelling Errors

In an attempt to minimize the inability of locating a record when the recruiting data was sent out to be geocoded, spelling checks were performed on street and city names. Initially, a random sample from the data set was taken and consisted of approximately three thousand records. Of those, twenty percent contained spelling errors in either the city or street name. Since this would hamper the geocoding process, a more thorough spell check of the entire file needed to be accomplished. Using Foxpro, the data set was first sorted by city name and then by street name. This process exposed the majority of obvious errors by, for example, having five separate rows in which the city of Cleveland was spelled differently. After checking the entire file for "near" like spellings, and correcting the rows with errors for both city and street names, it was believed that the majority of spelling errors were eliminated. A random sample, of the corrected database, of ten percent of the records revealed only two spelling errors.

Non-applicable Records

When a potential enlistee goes to a Military Entrance Processing Station (MEPS) and tests, notations are made to identify the individuals enlistment status. There are approximately sixteen different status codes an individual could be assigned, and as their status changes, so does their code. These codes can indicate a status range from being "Enlisted and Shipped" to basic military training, to being "Permanently Medically Disqualified", to having an "Insufficient Aptitude Percentile". Since the scope of this study is to look at the spatial distribution of potential and actual recruits from the state of Ohio, any individuals with status codes that reflect a potential to enlist or who actually enlisted were retained. This group included the following three statuses:

"Enlisted and Shipped" (to basic military training),

"Enlisted, not Shipped" (as of yet, to basic military training), and

"Partially Qualified" (making the assumption that these individuals will correct whatever their problem is, try to become fully qualified, and eventually enlist).

All records containing the other status codes were removed from the file because they reflected those individuals that were permanently disqualified for one reason or another, or those who were "Qualified, not Enlisted" and assumed to no longer have an interest in enlisting. This process removed 2,520 from the file, and was accomplished using Foxpro.

The remaining 13,084 still contained some that were not applicable to the study. As stated earlier, as a person progresses through the MEPS, their status changes. For example, assume an individual was coded "Partially Qualified" due to an inadequate test score. This

individual then retests, passes, decides to join the Air Force but opts to delay going to basic military training for a few months. The status code for this individual would now reflect their status to be "Enlisted, not Shipped". When this individuals shipping day arrives, and they actually depart for training, their status is again changed, becoming "Enlisted and Shipped". Each change of status of an individual generates an entirely new record, usually with all information identical to previous records except for the processing date, status, and test score (if that was the reason for the change in status). This was the scenario for the majority of newly generated records. A few records did have other information changed because something in the individuals personal life changed in this period as well- the person got married, had a child, graduated from school, etc. From all these records, the only one applicable to this study would be the one with the latest processing date. Using Foxpro and sorting the files by address revealed numerous duplicate records with individuals in varying stages of trying to enlist. Since so many of these non-applicable records existed, and it would be more time consuming to go through the file at this point to find and delete these records, it was decided to first send the file out for geocoding as this would reduce the file size by the number of records that could not be geocoded.

Geocoding

For a geographic information system (GIS) to be effective, it requires that data from different sources and themes can be integrated. This means that unrelated data sets are now related in some fashion. Links are created between data sets that might otherwise be unrelated. In a GIS, the desire is to relate these data sets geographically. To accomplish this,

the data sets must be geocoded. Geocoding is a process where each record in a data set is assigned to an area, such as a county, census tract, block group, school district, etc., that contains the record. This is accomplished by matching the address of the record against a geocoding database and thus assigning it to the proper area. More simply put, geocoding is a technology for linking postal addresses to points or areas on a map.

The Air Force enlisted recruiting data file was sent to Geographic Data Technology (GDT) in New Hampshire for geocoding. When the matching process was complete, about seventy-nine percent of the records had "hits", which means they were successfully matched to the requested areas of county and census tract. Some reasons for the approximate twenty-one percent that did not match include the following:

> City was present, but no addressed streets were in the database. This was possibly caused by addresses given as post office boxes or rural route numbers by potential recruits.
>
> Invalid locality name. Possibly caused by an undetected spelling error in the city name.
>
> Could not find the street name in the city. Possibly caused by an undetected spelling error in the street name.
>
> Could not find the address range on the street. This was possibly caused by incorrectly entering the address in the file when it was taken by the potential recruit.

The result was that the file, when returned from GDT, contained 9,864 geocoded records.

Duplicate Record Problems

When the data file was returned from GDT, the process of deleting non-applicable records was begun. These were the sets of multiple records on individuals reflecting changes

in status codes, where only the record with the latest status code was needed. To accomplish this, the records were sorted by street address using Foxpro. Since no key identifier existed for the records, such as a social security number or name, the entire database was reviewed line-by-line to delete the unwanted records. Social security numbers are used as key identifiers in the master file held at the Air Force Recruiting Service (AFRS) but due to privacy act requirements, these identifiers could not be released for this study since it was being conducted externally from the AFRS.

As the non-applicable record review of the file progressed, the duplicate record problem emerged. These records were exact duplicate copies of records, with all the information in them being exactly the same. This discovery caused the line-by-line database review to progress more slowly. To be as accurate as possible, each duplicate record had to be carefully reviewed, paying particular attention to the date of birth, processing date, sex, test scores, address, and status code. This was necessary to ensure oddities such as twins enlisting from the same household were not accidently deleted from the file. A program could have been written to accomplish this, but without a key identifier for each record, and with the large number of possible variables to check before determining a record was actually a duplicate before eliminating it, a careful line-by-line review of each record became the simplest and only available process. When the process was complete, 6,118 records remained. Of the 3,746 eliminated, 696 were exact duplicates of records, and the remainder were non-applicable status code records.

Data Manipulation and Aggregation

With the three data sets cleaned up and as accurate as possible, the next step of the process was to concatenate and manipulate them to ensure the variables and data were present that would be needed for the study. The process to concatenate the records was simply accomplished by joining the First Street demographic files with the Air Force enlisted recruiting files using the Statistical Package for the Social Sciences (SPSS). The resulting file was aggregated by county, then by census tract, and then saved as two separate files.

When manipulating the files, no actual changes to the data took place, but some additional variables were created based on the data that was already present. SPSS was the tool used to create the needed variables for the demographic and enlisted recruiting data, and ARC/INFO (a GIS software package) and SPSS were used to create a new variable for the boundary files. The following list shows the additional variables created from each source, and a definition for each variable.

Boundary Files from PUCO:

Miles from Metropolitan Areas - The five largest metropolitan areas in Ohio were selected. These included Cleveland, Columbus, Toledo, Dayton, and Cincinnati. Using ARC/INFO, the centroids for each were identified. The centroid for each census tract in the state was also identified. Then the distance from each census tract centroid to each metropolitan area was computed, and then refined, to produce a variable representing the shortest distance from each census tract to a major metropolitan area.

Demographic Data from First Street: (Variables were created at the county and census tract level for each variable)

Natural logarithm of population density

Percent of persons with a high school degree - computed by dividing the total number of persons with at least a high school degree by the total number of persons in either the county or census tract and multiplying by one-hundred

Number of White 17-21 year olds in Ohio

Number of Black 17-21 year olds in Ohio

Number of Asian 17-21 year olds in Ohio

Number of Hispanic 17-21 year olds in Ohio

Percent of Total 17-21 year olds - computed by dividing the total number of 17-21 year olds by county (or census tract) by the total number of 17-21 year olds in Ohio and multiplying by one-hundred

Percent of White 17-21 year olds - computed by dividing the number of White 17-21 year olds by county (or census tract) by the total number of 17-21 year olds in Ohio and multiplying by one-hundred

Percent of Black 17-21 year olds - computed by dividing the number of Black 17-21 year olds by county (or census tract) by the total number of 17-21 year olds in Ohio and multiplying by one-hundred

Percent of Asian 17-21 year olds - computed by dividing the number of Asian 17-21 year olds by county (or census tract) by the total number of 17-21 year olds in Ohio and multiplying by one-hundred

Percent of Hispanic 17-21 year olds - computed by dividing the number of Hispanic 17-21 year olds by county (or census tract) by the total number of 17-21 year olds in Ohio and multiplying by one-hundred

Air Force Enlisted Recruiting Data: (for each individual record)

Age - of each individual

Total Enlisted Recruits per 10,000 17-21 year olds - computed by dividing the total number of Air Force enlisted recruits by county (or census tract) by the total number of 17-21 year olds in the state and multiplying by ten-thousand

White Enlisted Recruits per 10,000 17-21 year olds - computed by dividing the number of White recruits by county (or census tract) by the total number of 17-21 year olds in the state and multiplying by ten-thousand

Black Enlisted Recruits per 10,000 17-21 year olds - computed by dividing the number of Black recruits by county (or census tract) by the total number of 17-21 year olds in the state and multiplying by ten-thousand

Asian Enlisted Recruits per 10,000 17-21 year olds - computed by dividing the number of Asian recruits by county (or census tract) by the total number of 17-21 year olds in the state and multiplying by ten-thousand

Hispanic Enlisted Recruits per 10,000 17-21 year olds - computed by dividing the number of Hispanic recruits by county (or census tract) by the total number of 17-21 year olds in the state and multiplying by ten-thousand

Percent of Total Enlisted Recruits - computed by dividing the total number of Air Force enlisted recruits by county (or census tract) by the total number of Air Force enlisted recruits for the state of Ohio and multiplying by one-hundred

Percent of White Enlisted Recruits - computed by dividing the number of White recruits by county (or census tract) by the total number of Air Force enlisted recruits for the state of Ohio and multiplying by one-hundred

Percent of Black Enlisted Recruits - computed by dividing the number of Black recruits by county (or census tract) by the total number of Air Force enlisted recruits for the state of Ohio and multiplying by one-hundred

Percent of Asian Enlisted Recruits - computed by dividing the number of Asian recruits by county (or census tract) by the total number of Air Force enlisted recruits for the state of Ohio and multiplying by one-hundred

Percent of Hispanic Enlisted Recruits - computed by dividing the number of Hispanic recruits by county (or census tract) by the total number of Air Force enlisted recruits for the state of Ohio and multiplying by one-hundred.

The data set for the project now consisted of all the variables in the two lists described in this chapter. Once all the additionally needed variables were obtained, the first process in setting up the data was to join the files (data by county and data by census tract) to the geographic boundary files to enable mapping of the data. These two files were separately selected in ArcView 2 sessions, concatenated with the PUCO geographic boundary files using the join function, and saved as two separate ArcView 2 projects. The key variables used in the join process were the FIPs variable for the county file, and the tract identification number

variable for the census tract file. The next chapter will discuss the spatial information products obtained from the data using ArcView 2, and an analysis of these products.

CHAPTER IV

SPATIAL INFORMATION PRODUCTS AND ANALYSIS

Data can be represented in many formats, to include spreadsheets, graphs, and even maps. These formats all strive to achieve the goal of presenting the data being studied in a "picture". To accomplish this, they must be able to focus the information being studied into one easy to read and interpret product. In a geographic information system (GIS), these formats are termed spatial information products (SIPs). They are clearly defined products, created by the GIS, based upon the data and transformations of the data. The product format chosen to represent the data in this study is the map.

Maps have existed for centuries as analog databases, capable of storing data not only about the location of entities, but also about the highly complex spatial relationships which exist between them. Additionally, methods to store very substantial amounts of spatial data in traditional map format have been developed, but the process to retrieve subsets of these data is most often time consuming and expensive (Marble, 1990). It is in this capacity that a geographic information system, ArcView 2, was used as a tool in this study. The GIS, storing the map data in a digital format, allowed for the desired subsets of the database to be quickly and efficiently extracted and mapped. The SIPs that were developed from this process may be found in the Appendix at the end of this document. Following is a general

description of these products, an analysis of what each conveys, and possible ways the Air Force Recruiting Service can use these and similar products to aid them in the recruiting process.

Spatial Information Products - General Descriptions

For the purpose of this study, two levels of aggregation were used on the data, county and census tract. The same data variables were used in both levels to allow viewing of the data first in a general format (county level), followed by a more defined format (census tract level). This process not only allowed for a better understanding of the data, but the visual contrast of the two levels revealed observations not readily seen employing just one level of analysis.

In each level of aggregation, the following two analyses were conducted: 1) distribution of 17-21 year olds by race, in raw numbers and percentiles, and 2) distribution of United States Air Force (USAF) enlisted recruits by race, for the study period, in raw numbers and percentiles. The race breakdown includes Whites, Blacks, Asians, and Hispanics. This breakdown accounts for 99.08% of the total 17-21 year old cohort, and 99.51% of the USAF enlisted cohort. The remaining 0.92% and 0.49%, respectively, include such race groups as American Indians, Eskimos, etc., and were grouped together and defined as "Other". Subsequent to a careful review, this "Other" group was considered too negligible to provide any meaningful observations to the study.

Although all the distribution analyses showed where cohort groups were located, the raw number and percent breakdown categories revealed different information. The raw

number distribution of 17-21 year olds by race provided an overview of how many potential enlistee candidates were available in each area, while the percentile distribution revealed, by location, their concentration compared to the entire cohort. For the USAF enlisted recruit data, the raw number distributions provide an overview of how many actual shipped, waiting to be shipped, and partially qualified individuals there were in each area per ten thousand 17-21 year olds. Their concentration in each location is represented by the percentile distribution. The "per ten thousand 17-21 year olds" transformation accomplished two goals. First, since only 0.72% of the total 17-21 year old cohort became USAF enlisted recruits (as defined earlier in this paper), and the numbers for individual races were quite small, it helped to better visualize the small numbers involved. Second, as will be seen in the next chapter, it made the statistical regression analysis easier to comprehend since the data was extremely positively skewed due to the small numbers involved.

Since many of the concentrations are so small, or were located within urban areas, and due to the fact that many of the urban areas are dense with census tracts, the census tract borders obscured much of the data. To alleviate this problem, SIPs depicting census tract information had the census tract borders removed to allow better visualization of the data. To aid in more closely determining a location, or any existing spatial relationship, on a county or census tract SIP, the provided overviews of Ohio can be used as overlays to better define areas of interest. With the general description of the SIPs now in place, the next section will attempt to analyze each of the products for content and possible use.

Spatial Information Product Analysis

Each SIP product in this study is essentially a graphic representation of the data described in chapter three. To answer the primary questions of this study, namely "where are the potential enlistee candidates located" and "where have the recruits the USAF has now come from", the data was queried, broken into subsets, and mapped. Each subgroup is mapped at two levels, county and census tract. To be able to effectively identify spatial patterns and features, this section will look at the maps in the following way. First, the county, or big picture, view will be analyzed to find any general trends that might be present. Immediately following will be the census tract, or more disaggregate, view to try to identify spatial subtleties in the data. To answer the above questions in order, the distribution of the 17-21 year old population will be discussed first, followed by the USAF enlisted recruit population. SIPs will be referred to by their assigned figure number and, as stated earlier, can be found in the appendix at the end of this document.

Ohio Overview

The state of Ohio is divided into eighty-eight counties and two-thousand eight-hundred and sixty-two census tracts (see Figures 3 and 4). As can be seen in Figure 3, a well established interstate system connects the largest of Ohio's cities. Census tracts, depicted in Figure 4, are quite dense in the cities since more are needed to maintain the average census tract population of approximately four-thousand people. Comparing Figures 3 and 4, it is easily determined that the densest populations coincide with the urban areas, which are the large cities. Figure 4 also shows some census tracts extending out into Lake Erie to the north

of the state. These tracts take into account some of the islands in Lake Erie that are part of Ohio, as well as State Protected and Wildlife areas which are labeled as census tracts for accounting purposes, even though they are completely uninhabited.

Raw Number Distributions of 17-21 year olds

The SIPs depicting the raw number distribution of the 17-21 year old cohort in Ohio (Figures 5 and 6) basically reinforce logical preconceptions about the population distribution. These preconceptions include such items as the population is more dense in those counties containing large metropolitan areas, and for those counties which reside along the road network of the major interstate system. Figure 6 goes one step further by showing that the concentration of the targeted youth cohort resides in the suburbs of the major metropolitan areas, rather than within the metropolitan areas themselves. An initial deduction would suggest that if one wanted to recruit from this population, then recruiting stations on the periphery of the urban areas may be more visible, and possibly more productive, then recruiting stations within the cities themselves.

Figures 7 and 8 show the raw number distribution of the White 17-21 year olds in the state. Since this cohort is 85.2% of the total youth cohort, it is expected that their distribution would mirror that of the total population. To all intents and purposes, these figures suggest just that.

The Black youth cohort comprises 12.12% of the total study cohort. Figures 9 and 10 graphically depict this subgroup. From Figure 9 some basic observations can be made. One of the first is that there are three counties in the state that had no black population in the

cohort age group at the time of the census. The next observation is that, although the number of individuals is quite a bit less, the distribution of the Black population is very similar to that of the White and Total population. Figure 10, on the other hand, shows a marked difference in where the Black cohorts are actually situated. While the White cohort exist in greater numbers around the periphery of the cities, the Black population is found much less in the suburbs, and much more within the city.

As with the Black cohort, the Asian cohort is absent from three Ohio counties, although not the same three counties as the Blacks (see Figures 11 and 12). The Asian cohort comprises only 1.05% of the total study youth cohort, so to find any area densely populated by Asian youth is not really expected. As with the White and Black cohorts, an initial look at Figure 11 shows that the distribution of Asians is primarily near the metropolitan areas. A closer look, achieved with Figure 12, reveals that there are very few areas in the state with any dense Asian population. Their actual distribution appears to be pretty uniform throughout the state, and any density peaks that do occur are in the urban areas.

The Hispanic cohort comprises 1.63% of the total study cohort. Except for the three metropolitan areas in the southern half of Ohio, most of the population appears to reside near the northern border (see Figure 13). Upon closer examination, using Figure 14 at the census tract level, it is quite easily determined that the vast majority of the Hispanic cohort resides in the northwest corner of the state. If one were to remove this area, the remaining population is quite evenly distributed throughout the state, save for the three southern metropolitan areas mentioned earlier.

Percent Distribution of 17-21 year olds

As stated at the outset of this chapter, the distributions reviewed above only reveal raw numbers on how many individuals in a cohort are located in an area. Although this method gives an idea of where the groups are located, it can be misleading when looking for areas of concentration within these groups because no standardization of the data has taken place. The larger an area, for example an urban area, the more people one would expect. To more precisely find concentrations of any particular group, distributions of that group need to be viewed in a way that relates each individual area to the whole. This was accomplished in this study by determining percentages for each cohort subgroup. This related each individual area in a particular geographic level to that of the entire state. Now, instead of simply seeing how many of a particular cohort were in each county or census tract, the percentage of the cohort in that area is seen in relation to the other areas around the state. This in turn allows for a better analysis of the distribution of individuals in a cohort and provides some insight on where one should concentrate efforts to get the maximum possible access to a particular group.

Figures 15 and 16 show the concentrations of the total 17-21 year old cohort for the state of Ohio by county and census tract, respectively. The main deduction obtained from these products is that the concentration of this cohort is extremely uniform throughout the state. Figure 15, the county map, indicates that concentrations are slightly higher near the major urban areas. However, a glance at Figure 16, the census tract map, shows this is due to a few isolated census tracts within each of these counties. Other than these few isolated areas, the concentrations of 17-21 year olds is uniform.

As was seen in the raw number distribution analysis, the percent distribution for the White cohort almost mirrors that for the total youth cohort due to the large percentage of White youth (see Figures 17 and 18). However, figure 18 shows an interesting feature. Although small, there are a few areas that have no concentrations of White youth at all. Comparing these areas with the other cohort products, as yet introduced, reveals that these areas are populated by one of the other subgroups. Other than this, the distribution of the White cohort is basically uniform throughout the state.

The Black and Asian cohort distribution initially appear quite uniform when observed at the county level, but change rather significantly at the census tract level (see Figures 19 through 22). Again, as expected, higher concentrations of these groups are found in the counties encompassing Ohio's large cities (see Figures 19 and 21). When viewing the cohorts at the census tract level (see Figures 20 and 22), however, it is revealed that many portions of these counties are completely absent of members of these two groups. This fact is more easily observed by overlaying the county border map (Figure 3) on top of these census tract maps. The Black cohort is more uniformly distributed then that of the Asian, yet have higher concentrations in the inner city. The Asian cohort concentration, although small, appear in clusters throughout the state, with the highest concentration in Columbus.

The percent distribution of the Hispanic cohort probably best depicts the value of viewing the distributions in a standardized format versus raw numbers. Earlier in this chapter when reviewing this cohort in the raw number distribution format, the product (Figure 14) suggested that the largest number of Hispanics resided in the upper northwest corner of the state. In actuality, by referring to Figures 23 and 24, it is clearly seen that the highest

concentration of Hispanics resides near Cleveland. There are almost as many Hispanics in the Cleveland area as in the entire northwest corner of the state. By referring to Figure 24, and more easily visualized by overlaying the county border map (Figure 3) over Figure 24, it is observed that of this area, the highest concentration appears to reside in "downtown" Cleveland. It is important to remember to occasionally review Figure 4 to make note of any dense concentrations of census tracts in a particular area of interest. It can be concluded from Figure 24 that close to all of the census tracts in the "downtown" area of Cleveland are almost entirely populated by Hispanics.

The greatest value of the percent distribution format has been alluded to throughout the above analysis. To state it clearly, it allows an investigator to pinpoint concentrations of cohorts for possible targeting operations. In this study, the investigators would be Air force recruiters. Knowing where the highest concentrations of Hispanics are, for example, allows them to effectively distribute resources in those areas, and hopefully garner more Hispanic recruits with less effort than before. To use an opposing example, it would be a waste of resources to attempt to recruit potential Hispanic recruits from the Cincinnati area where there is little to no Hispanic population. The percent distribution products allow a recruiter to determine where cohort concentrations exist, to effectively place resources in those areas to target that cohort, and hopefully yield more recruits. In the following sections, the USAF enlisted recruit cohorts will be analyzed. The process will be to discuss what each product conveys, and then see how close the actual recruiting of individuals compares with the above analysis of where targeting for potential recruits should occur.

Raw Number Distributions of USAF Enlisted Recruits

The number of recruits in the USAF enlisted recruit cohort, for the study period, represent 0.73% of the total targeted population. Of the total USAF enlisted recruit cohort, 83.84% are White recruits, 15.06% are Black recruits, 0.48% are Asian recruits, and 0.62% are Hispanic recruits. Figures 25 through 34 graphically represent the total recruit cohort and each of the subgroups.

An initial glance at Figure 25 reveals that recruits have come from all but one county in Ohio over the study period. This county, and the adjacent counties to the east and southeast, are on the fringe of what is known as Appalachia. This area is extremely rural, relatively poor, and less populated then most other areas in the state. This may explain the low number of recruits coming from these areas.

The White, Black, Asian, and Hispanic cohort products (see Figures 27 through 34) closely follow the same patterns discussed in the raw number distributions of the 17-21 year old cohort analysis. Most White recruits came from the rural areas located well outside the cities. Many of the suburban areas directly outside the cities have some of the smallest numbers of White recruits. This is possibly due to more favorable employment opportunities in the cities. Additionally, since suburban areas tend to be wealthier neighborhoods, one might suspect that more money is available for attendance at institutions of higher education. Contrasting the White cohort is the Black cohort. On the whole, most Black recruits appear to have come from the urban regions and inner city (see Figure 30). Those in this group coming from outside these areas are too small in number to even study.

The Asian and Hispanic cohort products portray a completely different pattern than those for the other two groups mentioned above. In actuality, it can be stated that no pattern really exists at all (see Figures 31 through 34). A possible explanation for this may be due to the extremely small numbers of recruits in these cohorts. Looking at the county level products (Figures 31 and 33), it is accurate to say that Asian and Hispanic recruits come from those counties that have major metropolitan areas. This is as one would expect since metropolitan areas tend to be "melting pots" for ethnic groups. By looking at the census tract products (Figures 32 and 34), less of a defined pattern is observed. The Asian cohort appears to be more dense in the Dayton area, while the Hispanic cohort is more dense in the Toledo area. Both cohorts have some fairly large numbers coming from cohort specific census tracts in the Cleveland area.

As was stated earlier in this chapter, raw number distributions are good for visualizing available numbers of a particular group, but not very good to determine concentrations or make comparisons of groups. In the next section the focus will be on the percent distribution of the USAF enlisted recruit cohorts and an analysis of them to see if the recruits are coming from the areas one would expect them to come from. This analysis is most easily accomplished by comparing the percent distribution SIPs for the USAF enlisted recruits (Figures 35 through 44) to the percent distribution SIPs for the 17-21 year olds (Figures 15-24) already discussed.

Percent Distribution of USAF Enlisted Recruits

The percent distribution of total USAF enlisted recruits map (Figure 35) shows that the majority of recruits are coming from areas situated near metropolitan areas. As the distance increases from a major city, it appears that the level of recruitment decreases. This result is expected since the metropolitan areas are more densely populated with potential enlistees (see Figure 15). The pattern of recruitment for these areas is consistent with the population density. Hence, if the Air Force Recruiting Service wishes to increase the potential for obtaining recruits, their efforts should be focused on the major cities and the counties immediately adjacent to them. Since the White cohort is, in effect, the total cohort, the above observation pertains to them as well.

If, however, the Air Force Recruiting Service wishes to target other population subgroups, different targeting strategies are suggested by the SIPs. To recruit from the Black cohort, recruiting emphasis should be placed within the major cities and urban areas. Figures 39 and 40 reveal that this is where the majority of recruits have come from during the study period, and Figures 19 and 20 show that these are the areas with concentrations of potential Black enlistees. To expend resources in other areas of the state would be futile since there exists no concentrations of potential Black candidates to draw from.

The same is basically true for the Asian cohort as well. The majority of the Asian candidate population is located near Cleveland in the northeast, Dayton/Cincinnati in the southwest, and Columbus (see Figures 21 and 22). However, recruiting efforts should be limited to only two of the three areas mentioned above, the Cleveland and Dayton/Cincinnati areas. From the Asian enlistee maps (Figures 41 and 42), it is quickly determined that few

Asian recruits have come from the Columbus area. A possible explanation for this could be the fact that The Ohio State University is located in Columbus. The school has quite a large Asian enrollment, individuals who are in the 17-21 age group, which would be reflected in the census and thus show as a highly concentrated Asian area. However, since this subgroup of the Asian cohort is present only for the purpose of attending school, it could be considered a waste of resources to attempt to recruit this cohort from the Columbus area.

To suggest a recruiting strategy to target the Hispanic cohort is a bit more difficult. The amount of spatial variation is so great within this group that any conclusion could be basically termed a "guess". However, from Figures 23 and 24, it was determined that the greatest concentration of Hispanics were located in the Cleveland area, and the northwest region of the state just south and west of Toledo. These two areas suggest that efforts to obtain Hispanic recruits be focused there. Figures 43 and 44 tend to support this statement since the majority of potential candidates that were actually recruited during the study period came from these areas. Any further suggestions or conclusions based on the products depicting Asian and Hispanic cohorts would be highly suspect since these groups are resident in Ohio in such minute numbers.

Summary

Seen in this chapter is the ability of SIPs to graphically portray data. This medium is an extremely useful tool to aid in the analysis of the data and lends itself well to forming conclusions about the data. Many other products could have been generated to answer the multitude of questions an investigator might have about an area. For this study, the SIPs

presented did a good job in answering the questions of "where are potential enlisted candidates located" and "where have present enlistees come from". Naturally, other types of analysis, spatial and non-spatial, could be employed to further investigate the data and help answer these questions. In the next chapter, regression analysis is employed to carry out this task.

CHAPTER V

AN ANALYTIC VIEW

In the preceding chapter, spatial information products were presented that showed the spatial variation in a geographical format. In this chapter, the attempt is made to see if it is possible to provide a straightforward statistical explanation for these patterns of variability. In this light, regression analysis was used to try to find some explanation to the spatial pattern of variation that was observed, and see what other predictions could be made as to what areas in Ohio may be better targeted to yield enlisted recruits for the United States Air Force. This analysis will attempt to find the conditions that have an impact on recruiting numbers. The following is a discussion of the variables chosen, the regression results, and a brief discussion and interpretation of those results.

Regression Variables

As stated in Chapter I of this document, it would have been the ideal situation to have obtained data on why individuals joined the Air Force that included measurements of such items as "To serve country", "Love of country", "To get a better education", "To have a career", etc. Unfortunately, these types of variables do not exist in any quantifiable form.

Selected for the regression analysis were variables that were considered to be predictors of environment and thought to possibly have an impact on recruitment.

Since this study is focused on the total number of Air Force enlisted recruits and their breakdown by race, these variables naturally became the dependent variables in the regression analysis. Following is a list of the dependent variables and the designator used to refer to each throughout the analysis:

Total Recruits by County = $Y_{1(C)}$
Total Recruits by Census Tract = $Y_{1(CT)}$

White Recruits by County = $Y_{2(C)}$
White Recruits by Census Tract = $Y_{2(CT)}$

Black Recruits by County = $Y_{3(C)}$
Black Recruits by Census Tract = $Y_{3(CT)}$

Asian Recruits by County = $Y_{4(C)}$
Asian Recruits by Census Tract = $Y_{4(CT)}$

Hispanic Recruits by County = $Y_{5(C)}$
Hispanic Recruits by Census Tract = $Y_{5(CT)}$.

Each dependent variable above is normalized by the transformation "per 10,000 17-21 year olds".

As stated above, the independent variables selected for the analysis were those considered to have some relevance on, and possible reflect why, an individual would enlist in the Air Force. Following is a list of the independent variables and the designator used to refer to each throughout this analysis:

Percent High School Graduates by County = $X_{1(C)}$
Percent High School Graduates by Census Tract = $X_{1(CT)}$

Percent Unemployment by County = $X_{2(C)}$
Percent Unemployment by Census Tract = $X_{2(CT)}$

Per capita Income by County = $X_{3(C)}$
Per capita Income by Census Tract = $X_{3(CT)}$

Natural Logarithm of Population Density by County = $X_{4(C)}$
Natural Logarithm of Population Density by Census Tract = $X_{4(CT)}$

Natural Logarithm of Population Density, Squared, by County = $X_{5(C)}$
Natural Logarithm of Population Density, Squared, by Census Tract = $X_{5(CT)}$

Miles from a Metropolitan Area = $X_{6(CT)}$ (This variable is for Census Tracts only).

Variable Descriptions

The rationale for selecting the variables listed above was based on discussions with experienced geographers at The Ohio State University.

"Percent Unemployment" and "Per capita Income" were chosen because they are a measure of income and reflect the economic condition of an area. For these reasons, in areas of high unemployment and/or low per capita income, it is expected that recruiting levels will be higher. The perception is that these variables will reflect the motivation of an individual to enlist in the service to escape an undesirable economic condition.

Population density was chosen because it can be interpreted as an index of urbanism versus ruralism. Simply stated, the more individuals in the targeted age group that are in an area, the more there exists the potential to recruit from that area. Based on this assumption, the expectation is that the urban areas offer more opportunity from which to recruit since the possibility exists that more densely populated areas may lead to difficulty in an individuals ability to find employment.

Transformations had to be done on the original population density variable based on scatterplot results. To capture as much of the data as possible, the natural logarithm transformation was initially used. This helped straighten the plot out a bit, but still left a poor fit for much of the data. After some experimenting, it was found that squaring the natural logarithm of population density, and keeping both the transformed variables in the analysis, a fairly good fit was obtained.

For the census tract analysis only, the variable "Miles from a Metropolitan Area" was formulated. The five largest metropolitan areas in Ohio were utilized, which consisted of Cleveland, Columbus, Toledo, Dayton, and Cincinnati. Then, the distance from the center of each census tract in the state to the center of each of the five metropolitan areas was determined. The distance for each census tract to the closest metropolitan area is what defines this variable. The reason for its selection was the possibility that it might determine if distance from the major employment areas in the state had any effect on enlistment. What is expected to be observed is that the census tracts closer to the major metropolitan areas will have greater numbers of recruits. This hypothesis is based on the assumptions that first, there are more recruiters in the metropolitan areas and therefore are more visible to a potential enlistee, and second, the reasons stated above for the use of the population density variable also apply in this case.

Finally, "Percent of High School Graduates" was chosen to see if there was any correlation between the overall educational level of an area and enlistment numbers. Since the Air Force only allows three percent of its total enlistees to enter the service without a high

school degree, it is expected that areas with a low percentage of high school graduates would have smaller numbers of recruits.

Dependant Variable Problems

Stated earlier in this paper, and observed and discussed in the spatial information products analysis in Chapter IV, there are situations when every cohort is not represented in every area. In those situations, the counties or census tracts absent of the specific cohort being analyzed at the time were excluded from the analysis. Tables in the next section of this chapter will show the number of cases included in each regression analysis, as well as other pertinent information.

Due to the nature of the data, normality does not exist in all the cohort groups. Different methods were tested to remove the skewness, but there was little overall change to the regression results. Much more time and effort would need to be attributed to identifying the determinants of the skewness and a more indepth analysis performed. This was not felt to be necessary for the intentions of this particular study. Instead, the method executed in this analysis was to enter all the selected variables, report the results, and then formulate some modest conclusions based on those results. This is done with the understanding that a more indepth analysis needs to be accomplished if one wants to raise the confidence level of those conclusions.

Regression Results

The Statistical Package for the Social Sciences (SPSS) was the software package used to run the regression analyses. As stated in the prior section, all variables were entered into the analysis and the results are shown in Tables 1 and 2. Located immediately after the tables are the models determined from the regression analysis. The following list defines the notations being used, in addition to those described earlier for the variables:

DV = the dependent variable

N = the sample size

R^2 = the coefficient of determination

e = the error term

SEE = the standard error of estimate of Y

SigT = significance tests. This allows one to determine if the independent variable indicated has an effect on the dependent variable being analyzed. Those results marked with an asterisk (*) indicate significance at the 5% level (have a confidence interval of 95%). Values less than 0.05 are considered significant. Significance increases as the value approaches 0, and decreases as the value approaches 1.

Table 1. Regression Results for County Data

DV	N	R^2	SEE	SigT $X_{1(C)}$	SigT $X_{2(C)}$	SigT $X_{3(C)}$	SigT $X_{4(C)}$
$Y_{1(C)}$	88	0.2924	32.3	.0005*	.1039	.6621	.0000*
$Y_{2(C)}$	88	0.2939	32.1	.0004*	.1306	.7984	.0000*
$Y_{3(C)}$	85	0.1424	134.8	.9951	.1065	.5339	.0364*
$Y_{4(C)}$	85	0.0147	423.4	.8665	.4534	.5114	.7061
$Y_{5(C)}$	88	0.0792	374.8	.3686	.5719	.5524	.0664*

Table 1. Continued

SigT $X_{5(C)}$
.0002*
.0001*
.0667*
.6908
.0833*

Table 2. Regression Results for Census Tract Data

DV	N	R^2	SEE	SigT $X_{1(CT)}$	SigT $X_{2(CT)}$	SigT $X_{3(CT)}$
$Y_{1(CT)}$	2830	0.0307	111.5	.0000*	.2721	.6483
$Y_{2(CT)}$	2786	0.0175	232.6	.0000*	.0000*	.0575*
$Y_{3(CT)}$	2241	0.0038	791.2	.4409	.4242	.9920
$Y_{4(CT)}$	1680	0.0031	697.4	.2605	.6481	.7980
$Y_{5(CT)}$	2193	0.0020	411.1	.9907	.9150	.6583

Table 2. Continued

SigT $X_{4(CT)}$	SigT $X_{5(CT)}$	SigT $X_{6(CT)}$
.0000*	.0000*	.4638
.0241*	.0352*	.6105
.1471	.2596	.1148
.2176	.2139	.6881
.4132	.3946	.2014

Regression Models:

$$Y_{1(C)} = -434.1 + 3.907X_{1(C)} + 3.641X_{2(C)} - 0.002X_{3(C)} + 137.1X_{4(C)} - 10.9X_{5(C)} + e$$

$$Y_{2(C)} = -443.5 + 3.961X_{1(C)} + 3.356X_{2(C)} - 0.001X_{3(C)} + 139.9X_{4(C)} - 11.4X_{5(C)} + e$$

$$Y_{3(C)} = -763.7 - 0.031X_{1(C)} + 17.91X_{2(C)} - 0.010X_{3(C)} + 283.1X_{4(C)} - 21.9X_{5(C)} + e$$

$$Y_{4(C)} = 264.04 - 2.458X_{1(C)} - 22.7X_{2(C)} - 0.030X_{3(C)} + 165.7X_{4(C)} - 15.3X_{5(C)} + e$$

$$Y_{5(C)} = 1316.8 + 11.39X_{1(C)} + 14.58X_{2(C)} + 0.024X_{3(C)} - 686.85X_{4(C)} + 57.3X_{5(C)} + e$$

$$Y_{1(CT)} = -138.52 + 2.147X_{1(CT)} + 0.401X_{2(CT)} - 0.0002X_{3(CT)} + 52.32X_{4(CT)} - 3.79X_{5(CT)} + 0.078X_{6(CT)} + e$$

$$Y_{2(CT)} = -207.93 + 3.886X_{1(CT)} + 3.983X_{2(CT)} + 0.002X_{3(CT)} + 45.453X_{4(CT)} - 3.259X_{5(CT)} - 0.1136X_{6(CT)} + e$$

$$Y_{3(CT)} = -403.1 + 2.310X_{1(CT)} - 2.226X_{2(CT)} - 0.00003X_{3(CT)} + 117.7X_{4(CT)} - 6.87X_{5(CT)} + 1.342X_{6(CT)} + e$$

$$Y_{4(CT)} = -376.4 + 3.401X_{1(CT)} - 1.862X_{2(CT)} - 0.0009X_{3(CT)} + 122.8X_{4(CT)} - 9.152X_{5(CT)} + 0.3786X_{6(CT)} + e$$

$$Y_{5(CT)} = -84.91 - 0.018X_{1(CT)} - 0.182X_{2(CT)} - 0.0009X_{3(CT)} + 38.645X_{4(CT)} - 3.017X_{5(CT)} + 0.599X_{6(CT)} + e$$

Regression Results - General

Some solid observations can be determined from the regression analysis even though overall results of the analysis are not very favorable. This problem is most probably due to the skewness of the dependent variable data, and this skewness most likely results from the very small number of cases in some of the cohorts. Additionally, outliers in the variables

more than likely contributed to skewing the distribution. It was decided not to exclude them in the analysis, however, because with such a small sample size for some of the dependent variable cohorts, it would have been difficult to represent the population. Another problem discovered from the results was the evidence of multicollinearity. Actually, some multicollinearity was expected since the data making up the independent variables results mostly from observation, rather than experimentation. There do exist various remedies to the problems associated with multicollinearity, but to have attempted them would be beyond the scope of this paper.

The poor levels of explanation indicated by the small R^2s are, of themselves, interesting results. Based on the fact that the variables chosen are generally considered to be good predictors of environment since they depict an urban/rural continuum, as well as, an index of income and economy, one would normally have expected better results. One possible explanation for why the regression is explaining very little of the observed variation, even when using such gross factors as were represented by the selected variables, could be the differential in recruiting efforts.

At present, we have no idea of what the Air Force has done in one location versus another to entice individuals to enlist, or what one individual recruiter may do to recruit compared to another recruiter. This difference, however, could be the factor explaining the recruiting response for an area.

A second possible explanation for why little of the observed variation is explained is that we also have no idea of what competition Air Force recruiting for an area might face. This competition would influence possible recruits and inhibit them from considering the Air

Force as a career. Possible examples of competition would be the other armed services, higher education, and civilian employment. The more intense the competition, less the likelihood of the Air Force being considered since a potential recruit would have more options from which to choose.

Another possibility for the low R^2s may be in the data itself. The information being used for the independent variables is taken from the 1990 census, while the recruit cohort being studied is from fiscal year 1993 through the first quarter of fiscal year 1995. It is possible that changes in the demographics and economy over that period of time have been enough to influence the analysis. To remedy this situation, current data would have to be obtained and a more temporal analysis conducted. Undoubtedly, other factors besides those just mentioned are also involved and would need to be studied to allow a more formal statistical analysis to take place.

Regression Results - by Variable

Some positive results and conclusions were also obtained from the analysis. A significant relationship was determined to exist between the level of education in an area and the numbers of recruits enlisting from that area. This makes sense since the Air Force only allows approximately three percent of all enlistees a year to enter service without a high school degree. This significance was lost, however, when referenced to the Black and Asian cohorts. For a possible explanation, correlation tables were checked. These tables showed that the "Percent of High School Graduates" variable was inversely correlated to these two cohorts, and as the education levels in these areas decreased, enlistment for the area began

to rise. Considering that these two cohorts resided mainly in the inner city, and enlistment may be seen as a way to escape the urban areas, the results are plausible. Population density had the most substantial effect on the White cohort, and to a lesser extent on the Black and Hispanic cohorts, revealing that as this condition increased, so did the number of recruits. It is also possible that this result is simply reflecting the relationship between the gross number of people in an area and enlistment numbers. Simply stated, more recruits are coming from areas with more people since the potential recruit cohort is larger from which to select.

Analysis results showed a fairly strong correlation between the minority cohorts and the "Percent Unemployment" and "Per capita Income" variables. As these conditions rose, so did enlistments from these cohorts. These two independent variables and population density had the biggest effect and greatest significance on the White cohort. It appears that as the condition in an area worsens economically, enlistments in the Air Force increase, possibly becoming a desirable prospect in an attempt to escape this situation.

As previously stated, the above regression analyses are examples of the types of analyses that can be done. Admittedly, this analysis was not an indepth one, and a fuller statistical analysis might well reveal other interesting observations. The next chapter will provide a short summary of the problem, and the results, that were determined from this study. Additionally, suggestions for further research and what the next step of this study should be, were it to be continued, will be discussed. Finally, the use of a GIS and some possible benefits to the Air Force Recruiting Service will be presented.

CHAPTER VI

CONCLUSIONS AND SUGGESTIONS

Summary of the problem and the results

This study has been an attempt to use the technology of a geographic information system (GIS), and its methods of spatial analysis, to examine the spatial patterns of United States Air Force enlisted recruiting within the state of Ohio. The intent was to hopefully provide new insights into the areas of origin of present recruits, as well as identify those areas that would most likely serve as sources of future recruits. The main thrust of the study centered around a geographical analysis of the data since this was the one tool never used by the Air Force Recruiting Service when doing its analyses. A secondary analysis was conducted which consisted of a modest, traditional, statistical analysis that attempted to predict the role of significant geographic factors thought to be involved in the enlistment decision.

Using the technology of the GIS, spatial information products were developed to carry out the geographical analysis. These products portrayed the concentrations and locations of potential and actual enlistees in the state by county and census tract. These enlistees were further disaggregated into cohorts representing the four largest racial/ethnic groups in Ohio. To carry out the traditional statistical analysis, regressions were performed.

The goal here was to see if it were possible to predict the geographic areas from which recruits could be found.

The results of these two different types of analyses produced a similar conclusion. There exists in the state of Ohio a substantial spatial variation in the patterns of recruit generation. Due to this large amount of variability, it is difficult to identify a common, specific trend. Instead, each individual cohort had its own tendencies and patterns, and within each cohort at least a small measure of prediction could be accomplished.

The White cohort is mostly located in the non-urban environments, with recruits in this cohort coming from the suburbs of the large cities. Enlistment within the cohort seems sensitive to changes in the economy. The Black and Asian cohorts reside mainly within urban areas, with these areas providing the overwhelming majority of Black and Asian recruits to the Air Force. Changes in population density appeared to have the most impact on recruitment for this cohort. Members of the Hispanic cohort resided mainly in the northwest part of the state and the Cleveland area, with these areas providing the recruits. Again, changes in population density seemed to have the greatest effect on recruiting attitudes of this cohort.

Suggestions for further research

This study has shown how a GIS can be used to determine potential areas in Ohio for the recruiting of U.S.A.F. enlisted recruits. It has also shown where the individuals who joined the Air Force have come from for the last two and one-half years. With this knowledge it is possible to better define those areas that recruiters should target for enlisted

candidates. However, to really be able to garner the information being held in the data, I believe there are two areas of this study that need further cultivation.

First, a more intense geodemographic analysis should be attempted. This would include examining data at the school district and block group level to more accurately determine trends. Numbers and locations of recruiting stations in relation to schools, metropolitan areas, and the like should be examined to see what effect these distances and locations have on the recruiting process. Data should be explored that helps determine if relationships exist between distance from a military installation and the number of recruits from an area, the enlistment of any cohort group and the race/ethnic background of the recruiter, and much more. Unfortunately, these studies could not be accomplished because the required resources were just not available.

Second, a fuller, more complex, statistical analysis is needed to more properly explore the data and try to explain the patterns of variation in the spatial distribution. To accomplish this, additional socio-economic variables need to be investigated, as well as acquiring information about the levels of recruiting effort being employed by the Air Force and its recruiters. Additionally, more knowledge would need to be acquired about the response pattern to recruiting efforts by the other armed services. Is the Air Force competitive with them, are there wide differentials in recruiting between the services, and other such questions would need to be answered. Regression analysis should be used to its maximum extent to help predict possible conditions that aid in recruiting, and then employ the GIS to map the residuals as an aid in analyzing the results. Other statistical operations, such as cluster

analysis, factor analysis, and any others that apply should be conducted to explore the data to its fullest.

GIS benefits to Air Force recruiting

For the Air Force Recruiting Service, possible benefits to the use of a GIS can be suggested. The GIS technology could be actively used as a data retrieval and visualization system. By simply adding the county, census tract, school district, etc. codes to the data upon entry allows it to be readily used within the GIS. With the data entered, the visualization system could be employed. One possible use would be that the GIS can give a map display product to help to more easily interpret their present market analyses. A GIS would aid in analyzing these numbers, thus allowing a faster and easier comprehension of the results.

The query function ability of the GIS would allow the Air Force Recruiting Service to select almost any subset of their available data. This would allow them to ask a myriad of "what if" questions, and then get a graphical picture of the answer, as well as explore the new or revised data associated with it. Functions such as these offer the Air Force Recruiting Service immediate access to data for any location with a simple click of the computer mouse.

There are many other possible uses of a GIS for Air Force recruiting. These include trend analysis, redefining recruiting areas, tracking goal accomplishments for the individual recruiter up through the entire service, enlistment comparisons between all the military services, market analyses, location analyses for the placement of recruiting stations, etc. Many, many other possible uses arise, all allowing the Air Force Recruiting Service to explore possible spatial patterns through geographic visualization. Based on what this study was able

to accomplish, and the capabilities of spatial analysis that do exist, the potential use of the geographic information system should be heavily considered as becoming a main component of the Air Force recruiting structure.

APPENDIX

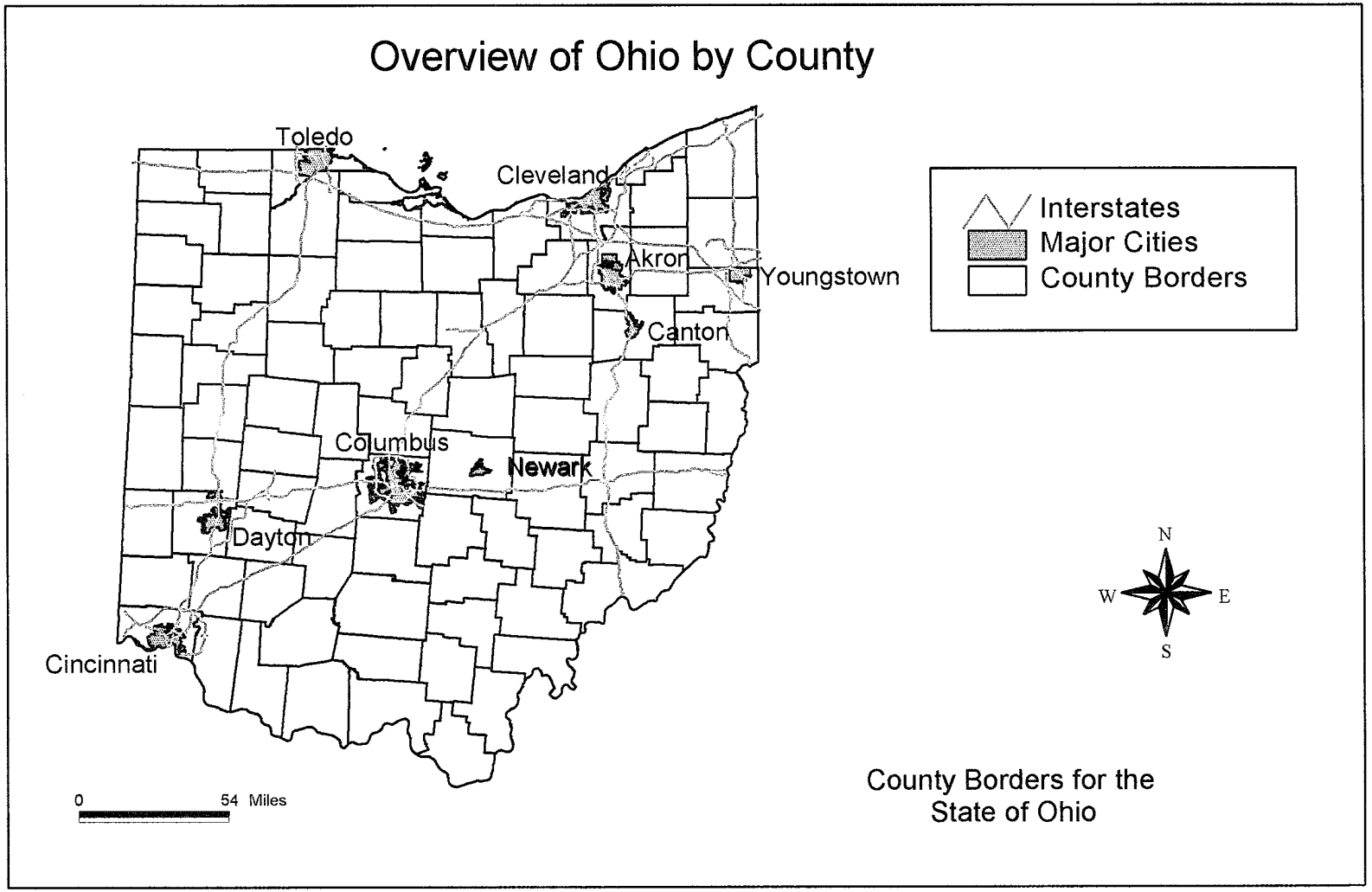


Figure 3. Overview of Ohio by County

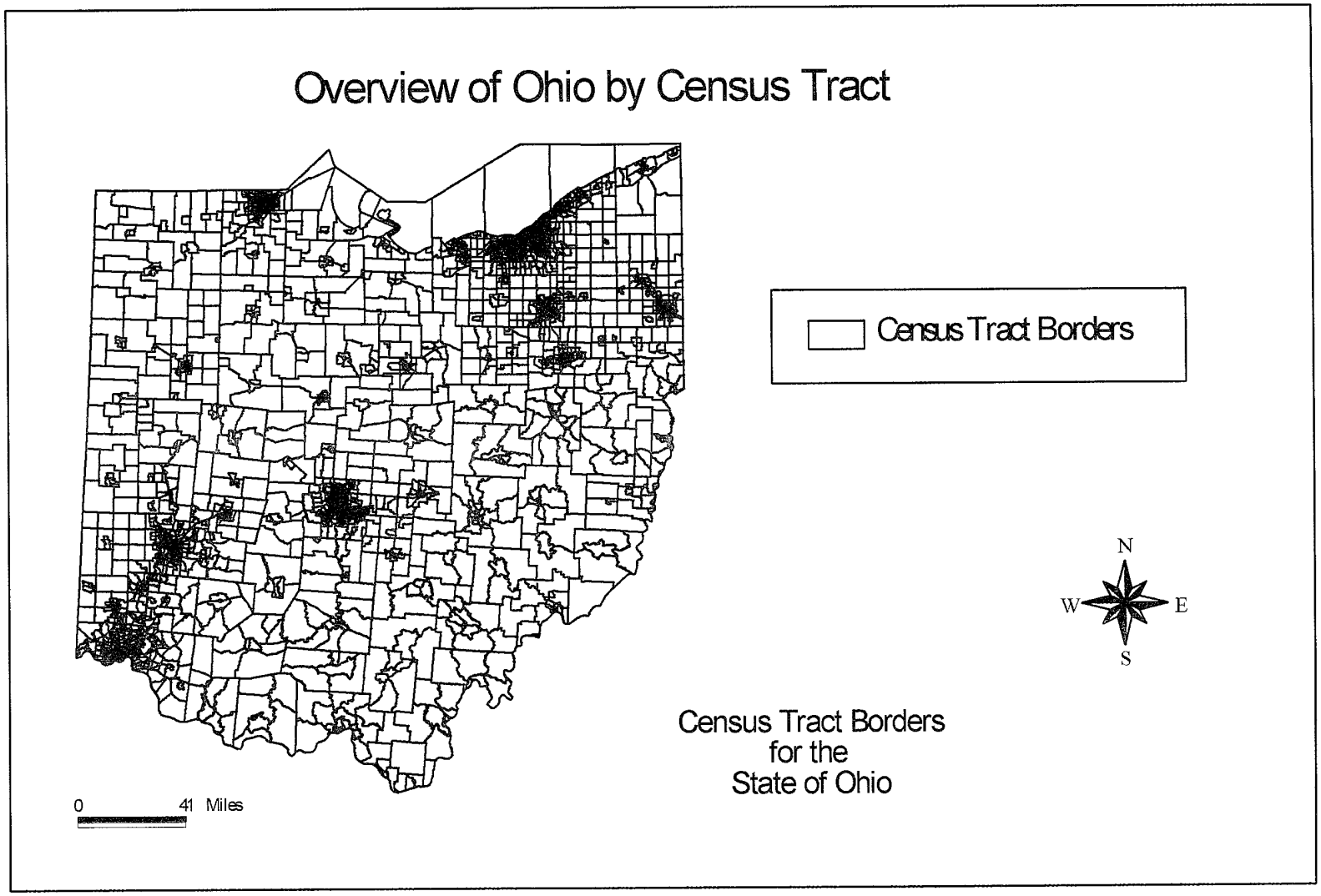


Figure 4. Overview of Ohio by Census Tract

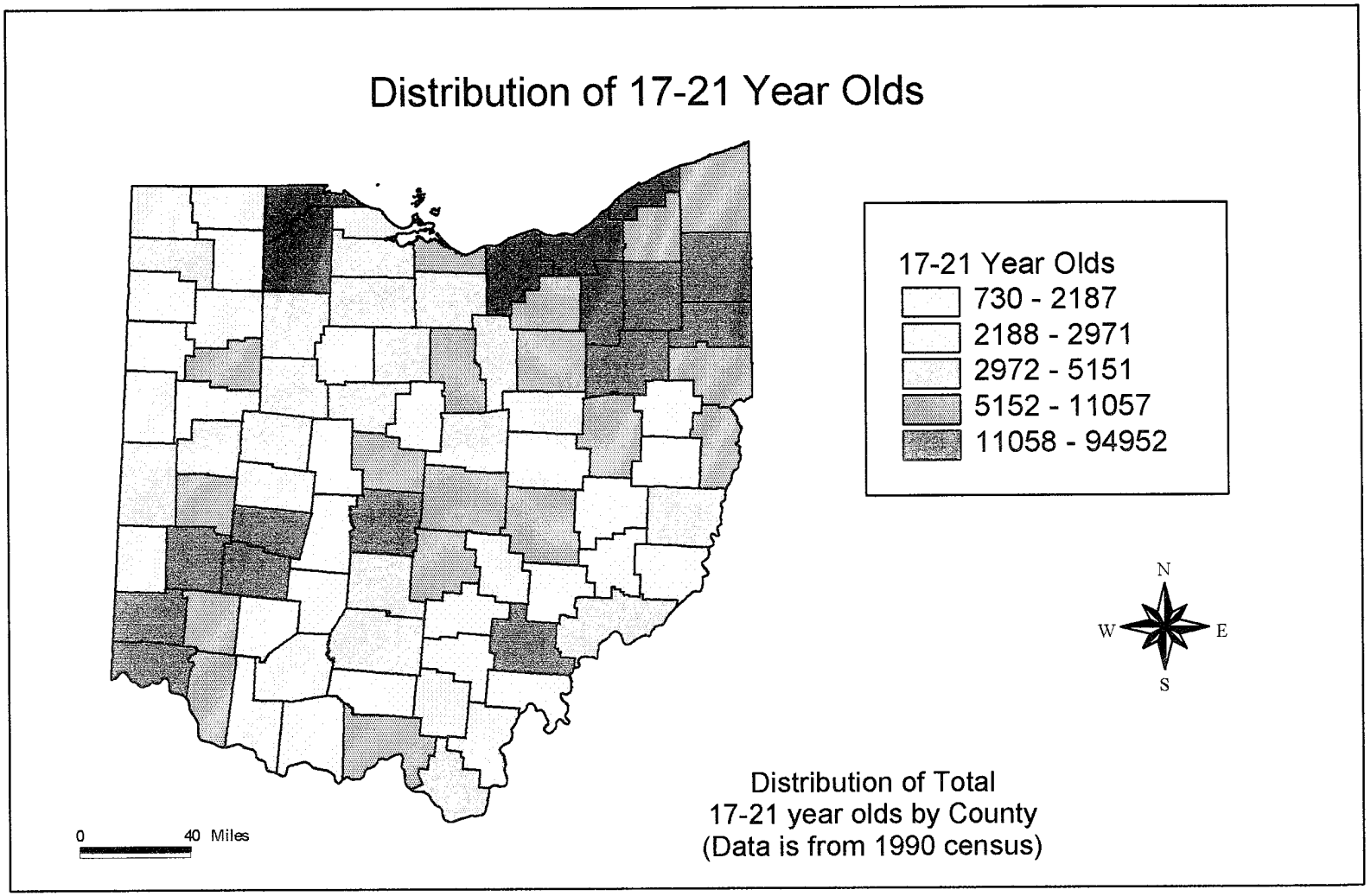


Figure 5. Distribution of 17-21 Year Olds by County

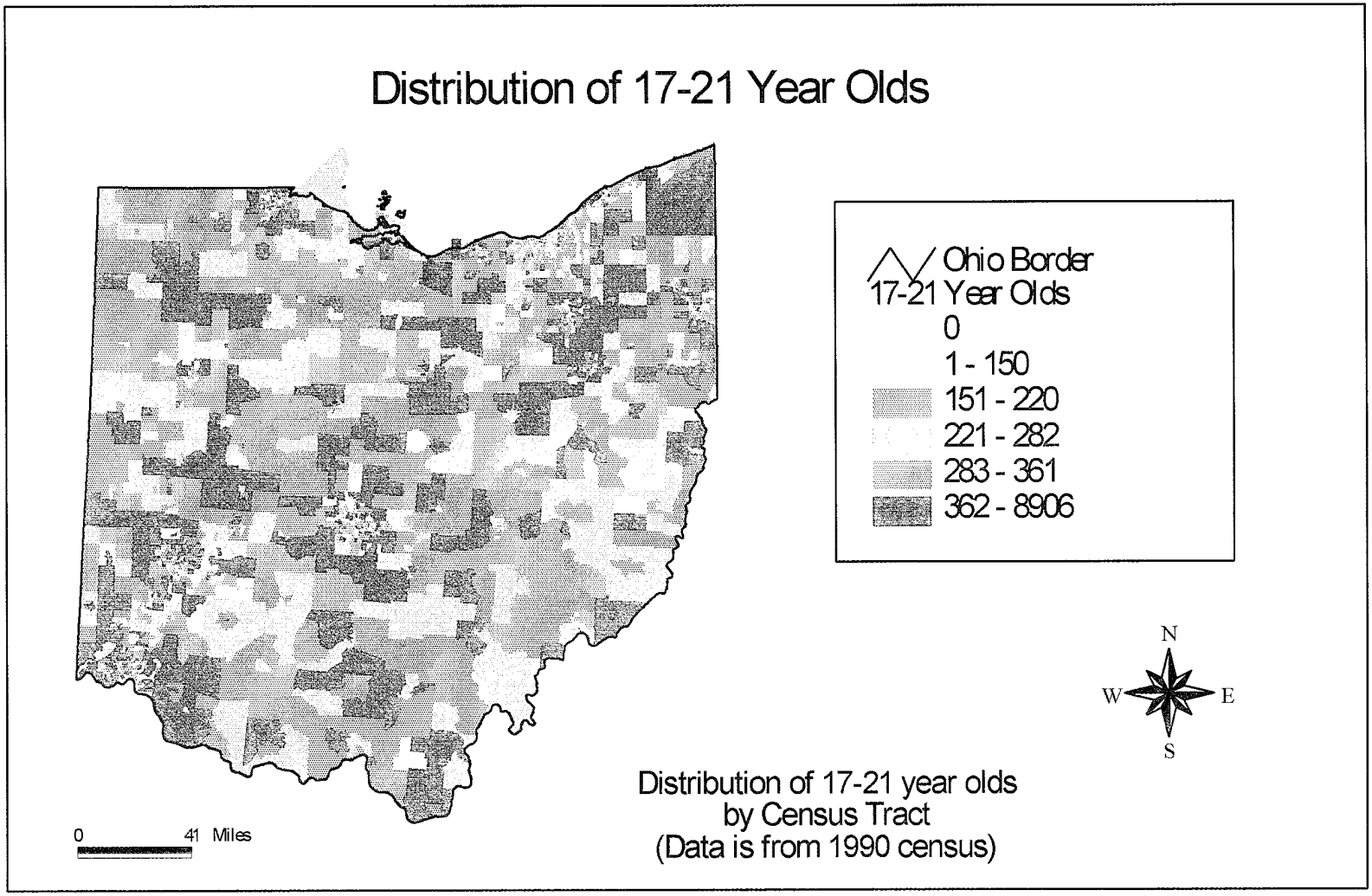


Figure 6. Distribution of 17-21 Year Olds by Census Tract

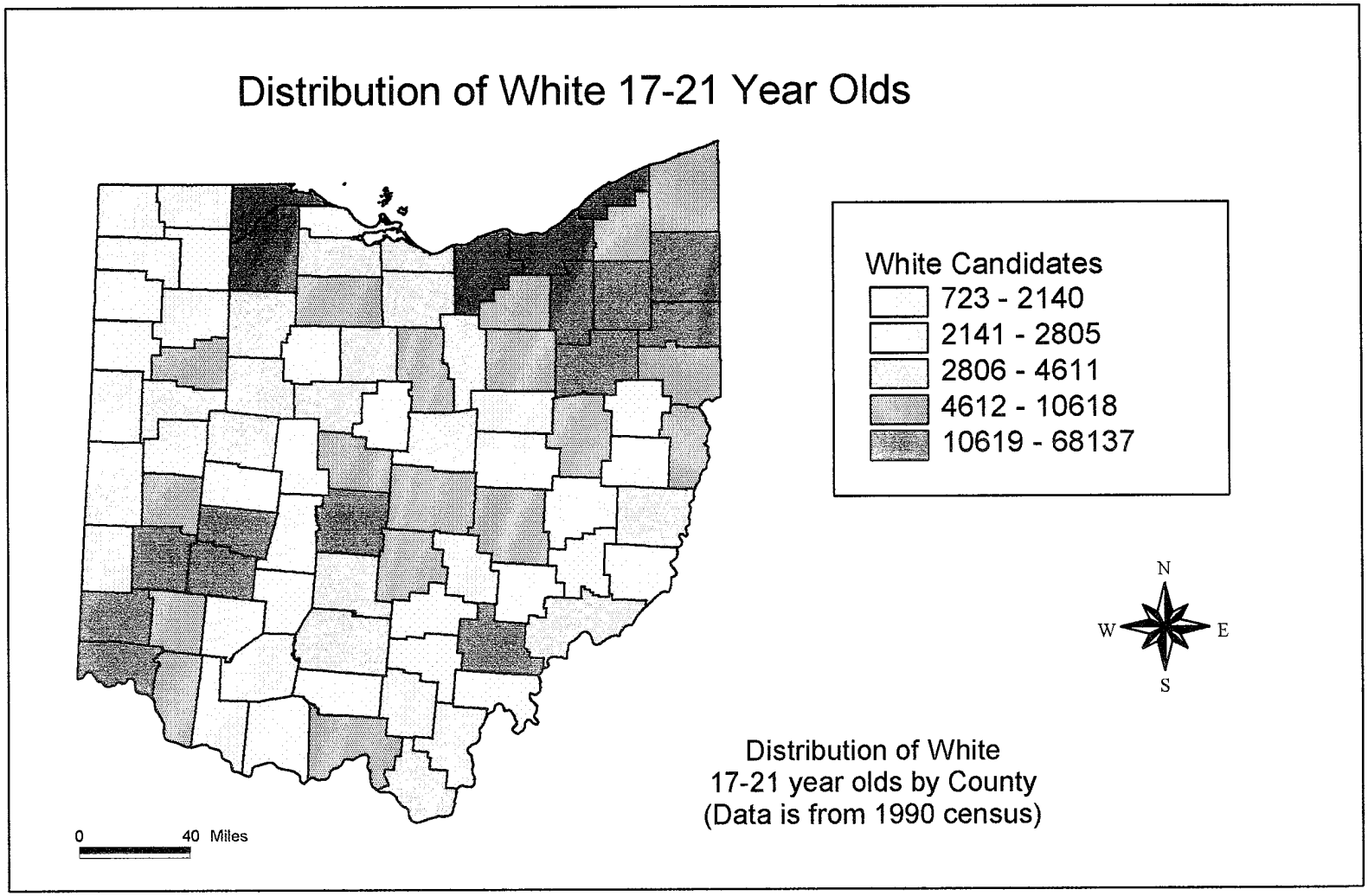


Figure 7. Distribution of White 17-21 Year Olds by County

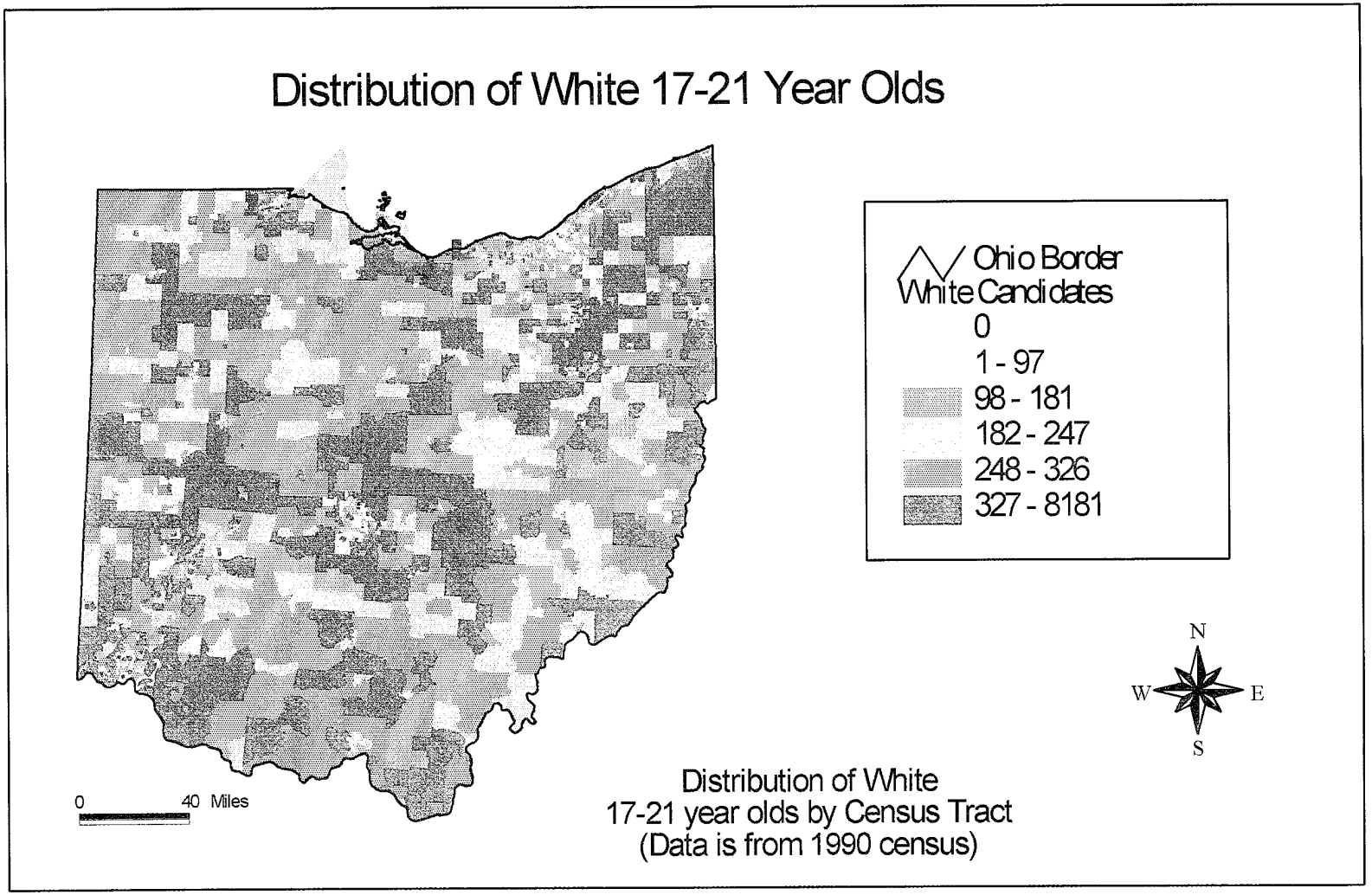


Figure 8. Distribution of White 17-21 Year Olds by Census Tract

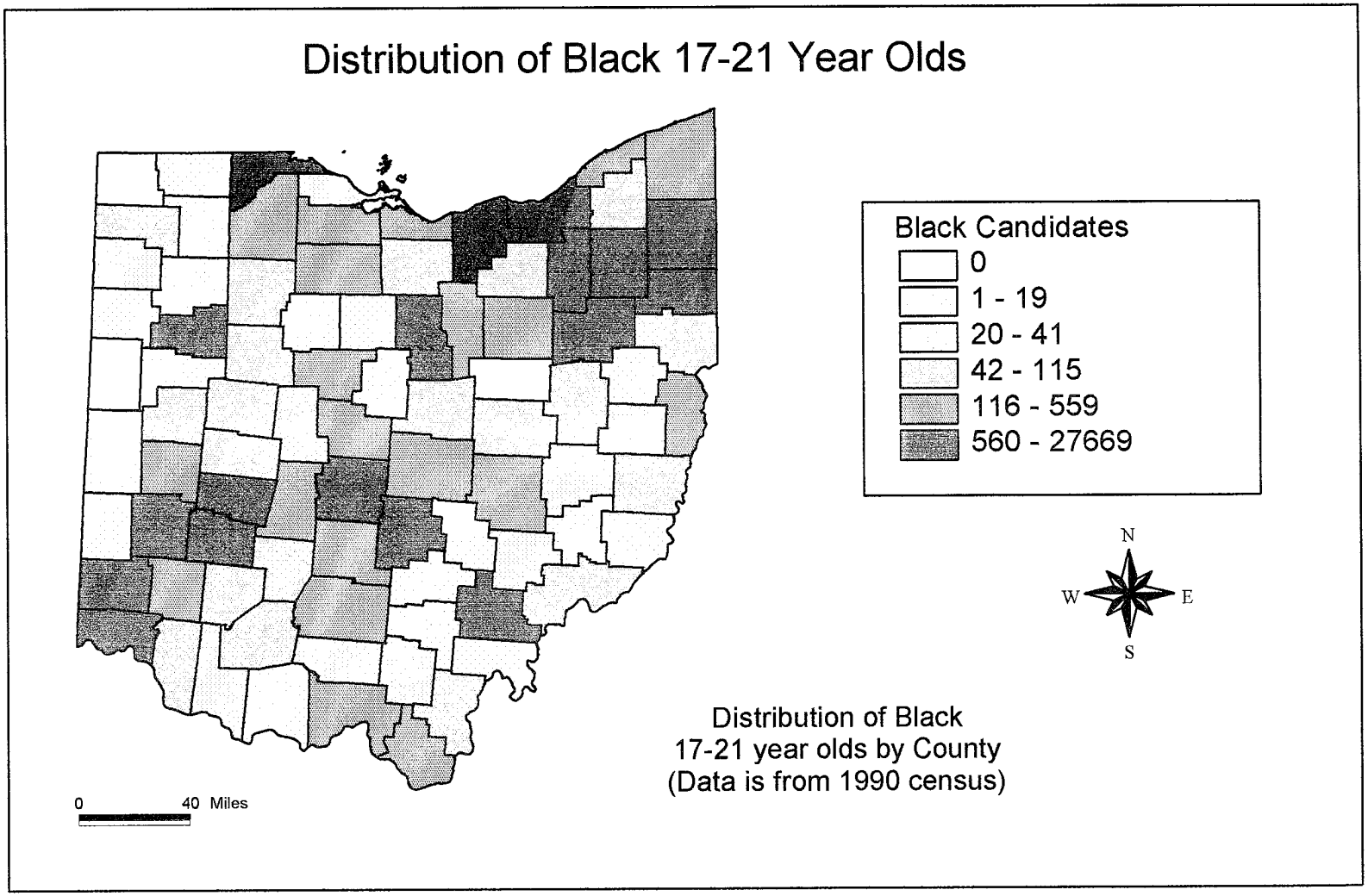


Figure 9. Distribution of Black 17-21 Year Olds by County

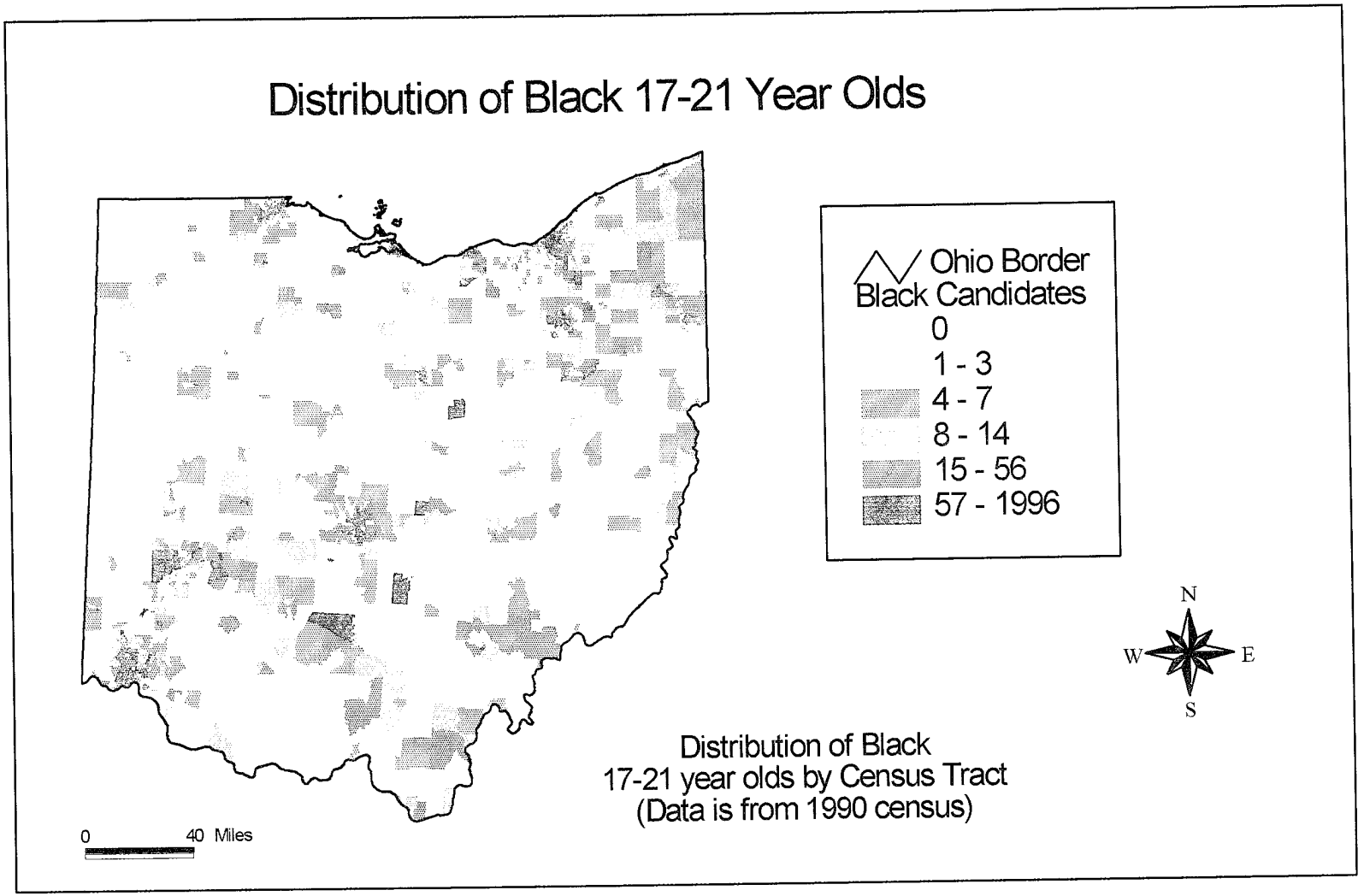


Figure 10. Distribution of Black 17-21 Year Olds by Census Tract

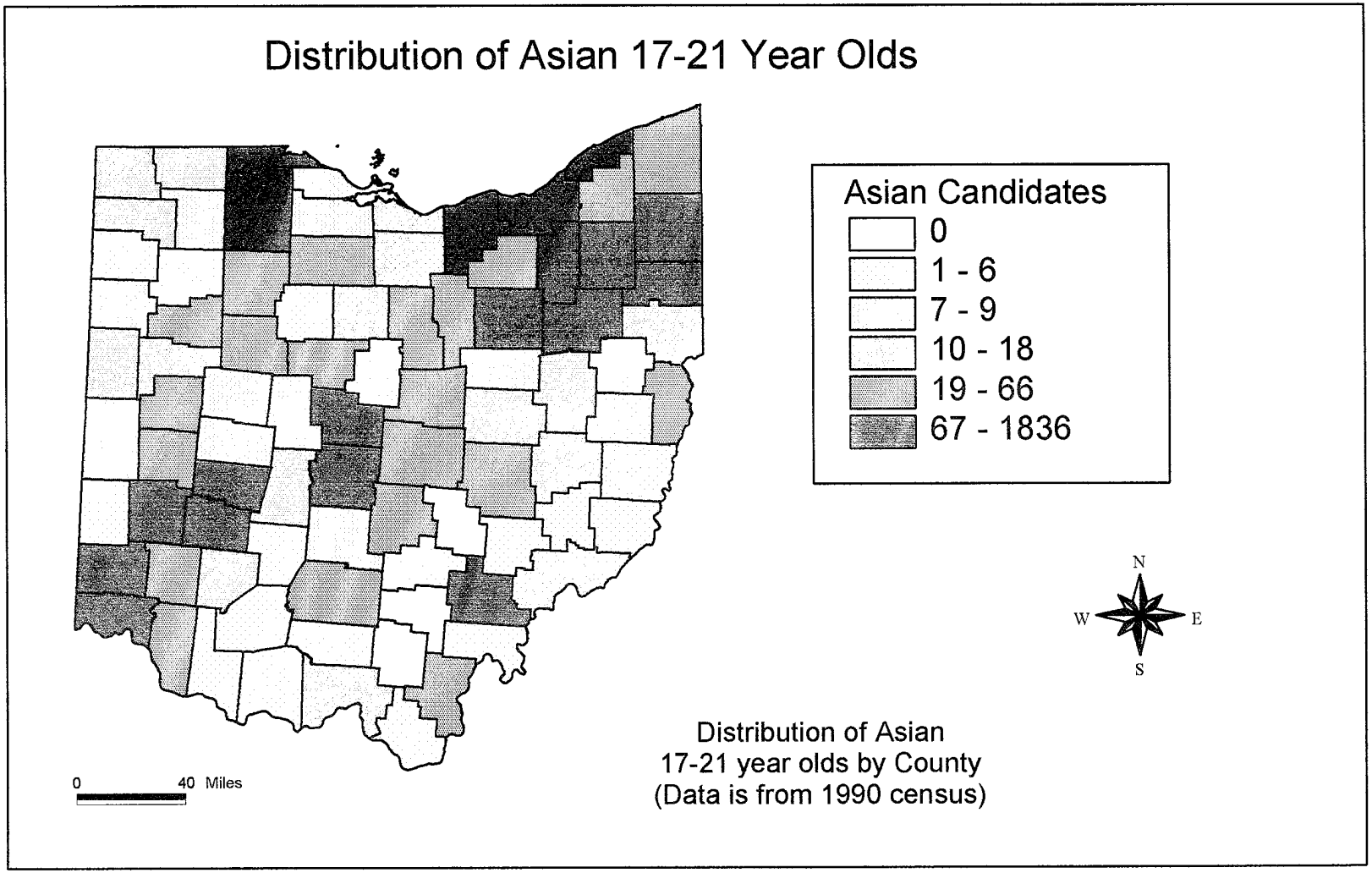


Figure 11. Distribution of Asian 17-21 Year Olds by County

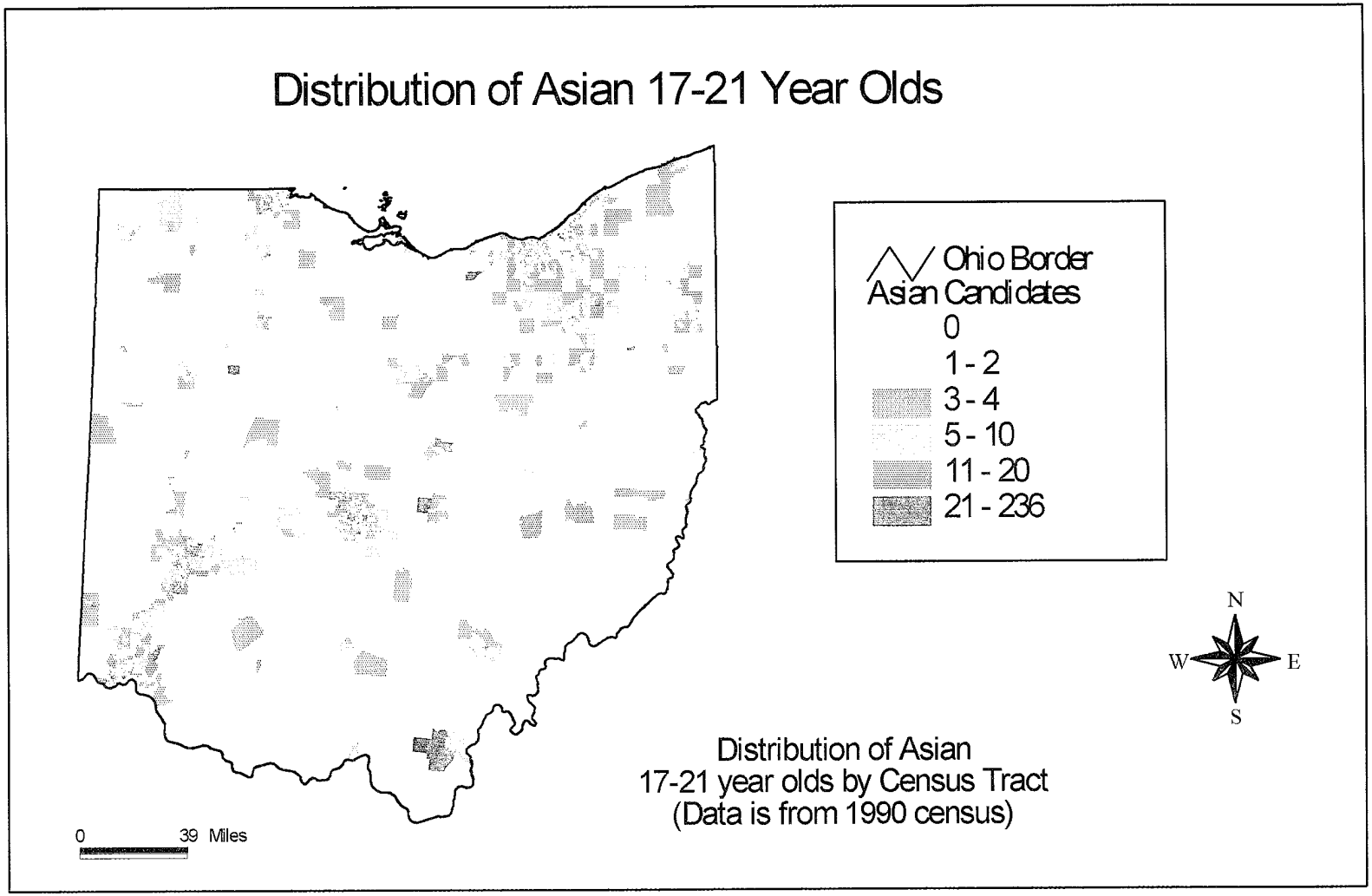


Figure 12. Distribution of Asian 17-21 Year Olds by Census Tract

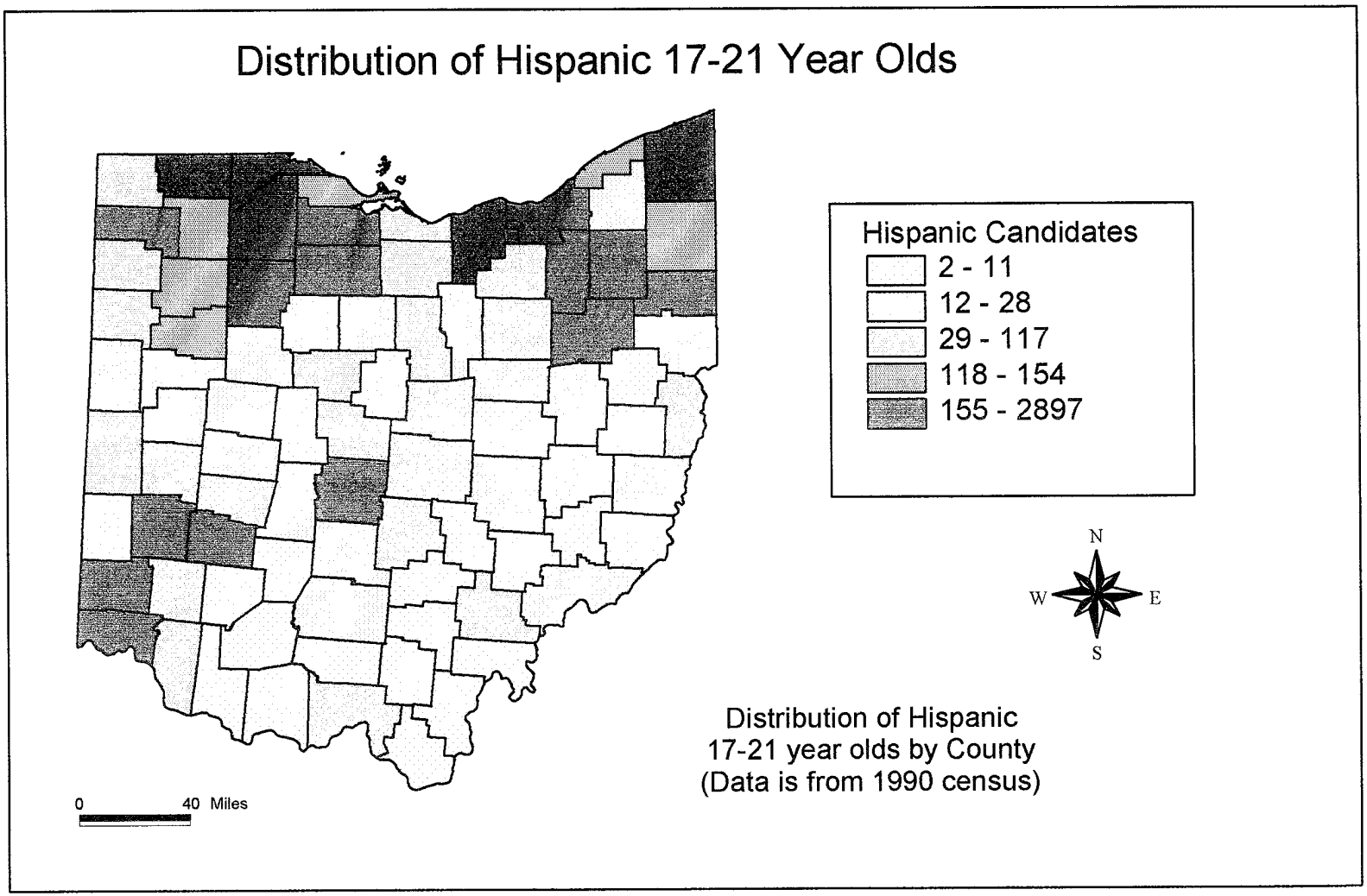


Figure 13. Distribution of Hispanic 17-21 Year Olds by County

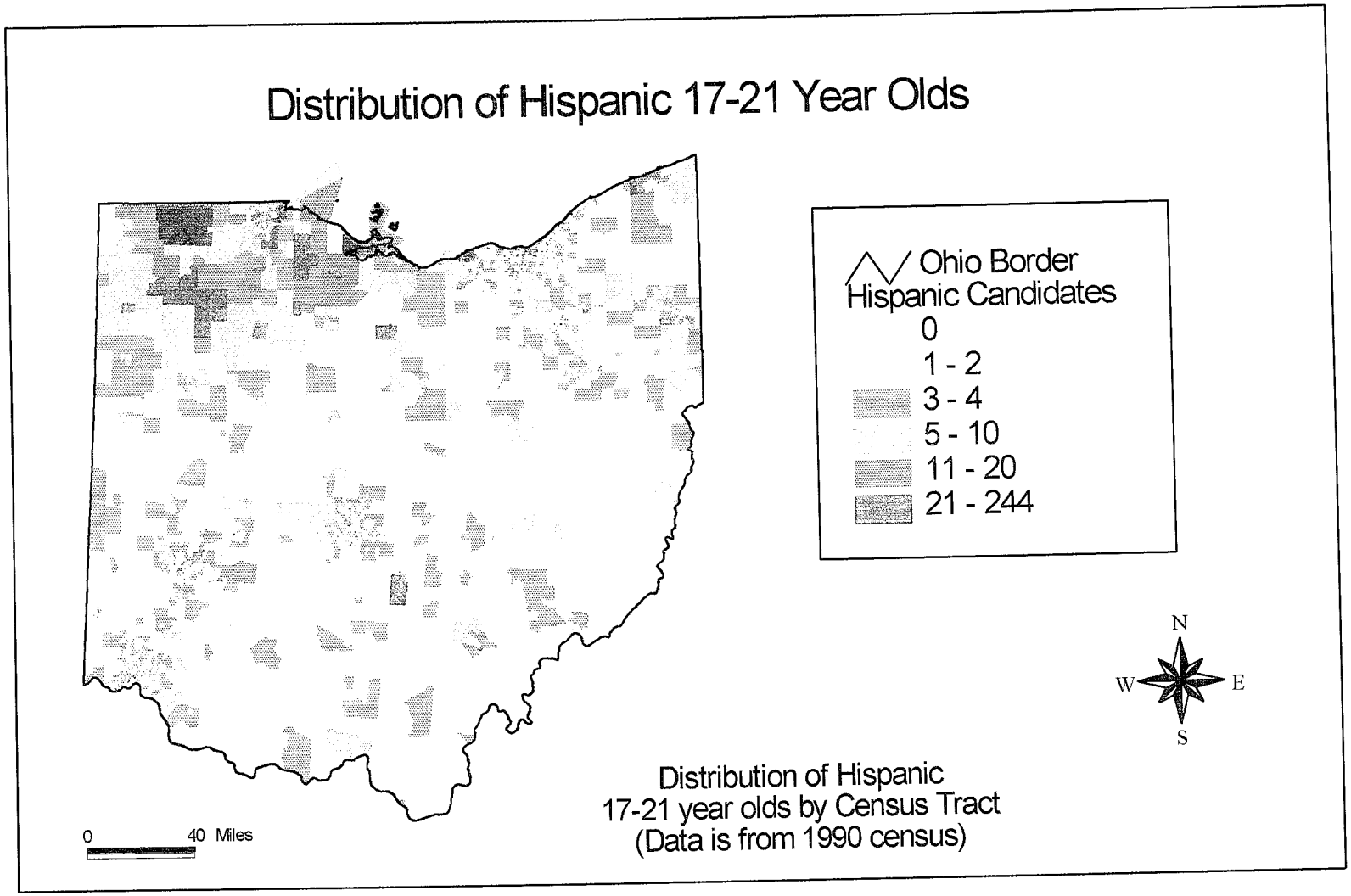


Figure 14. Distribution of Hispanic 17-21 Year Olds by Census Tract

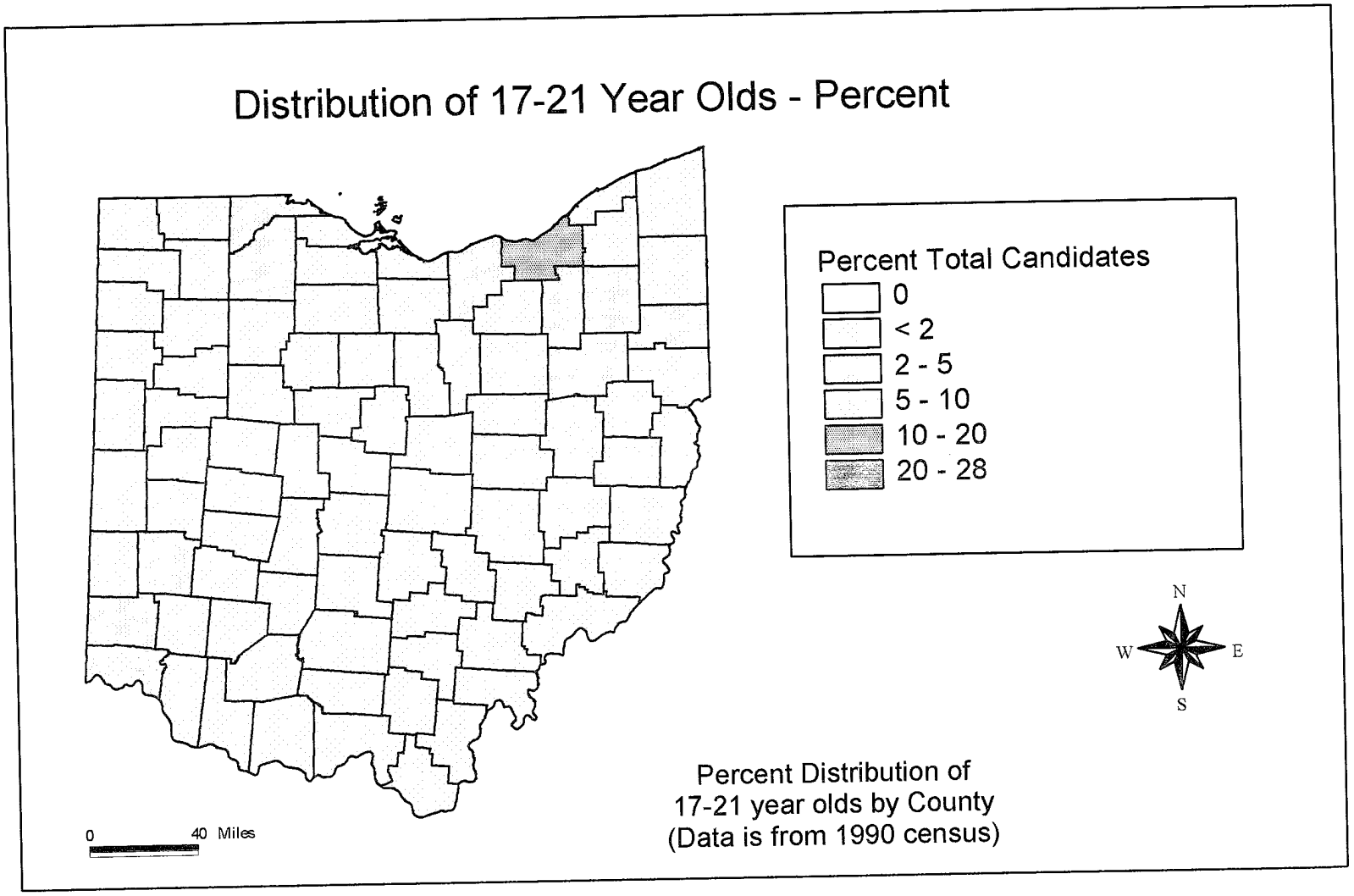


Figure 15. Percent Distribution of 17-21 Year Olds by County

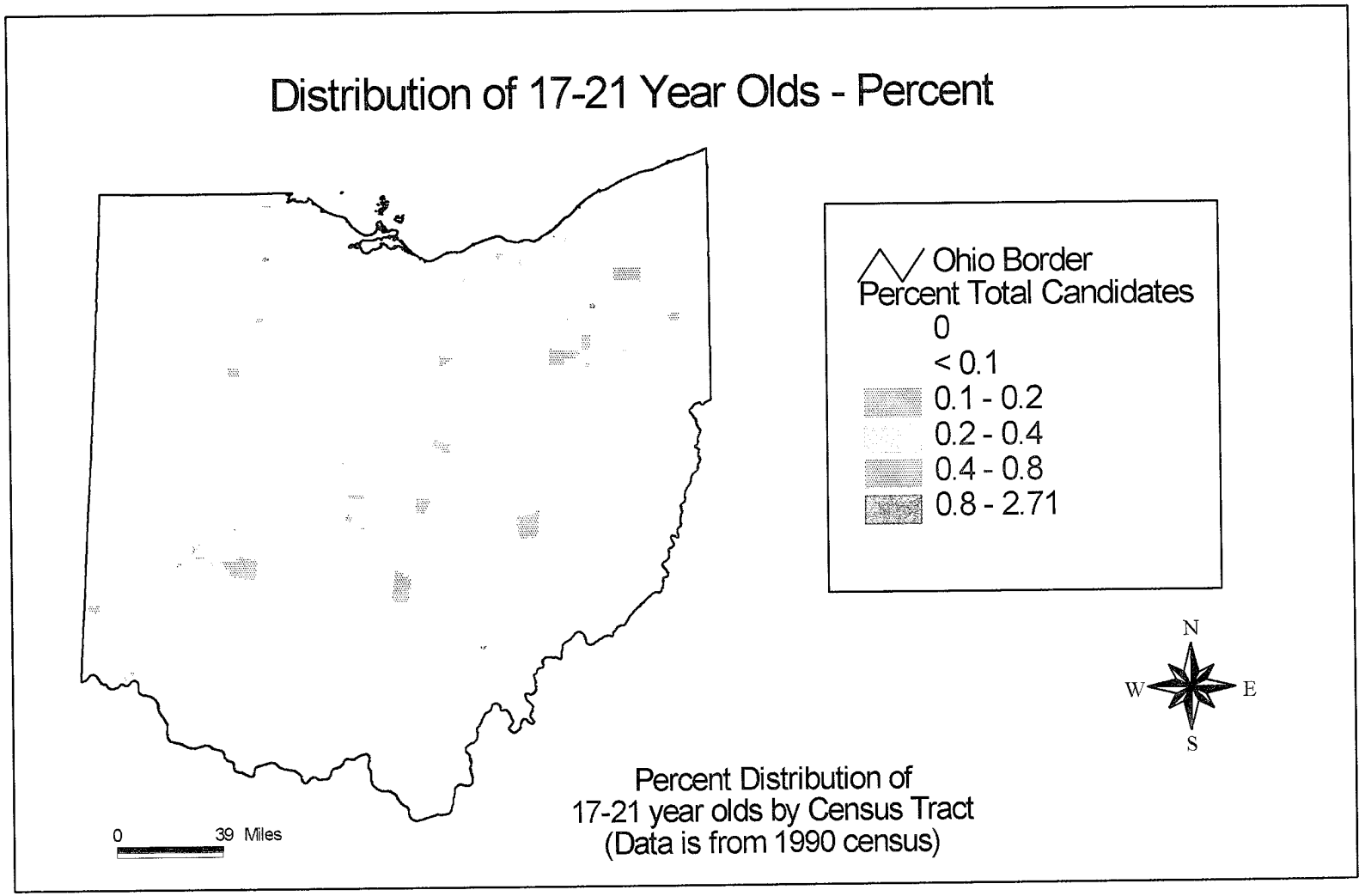


Figure 16. Percent Distribution of 17-21 Year Olds by Census Tract

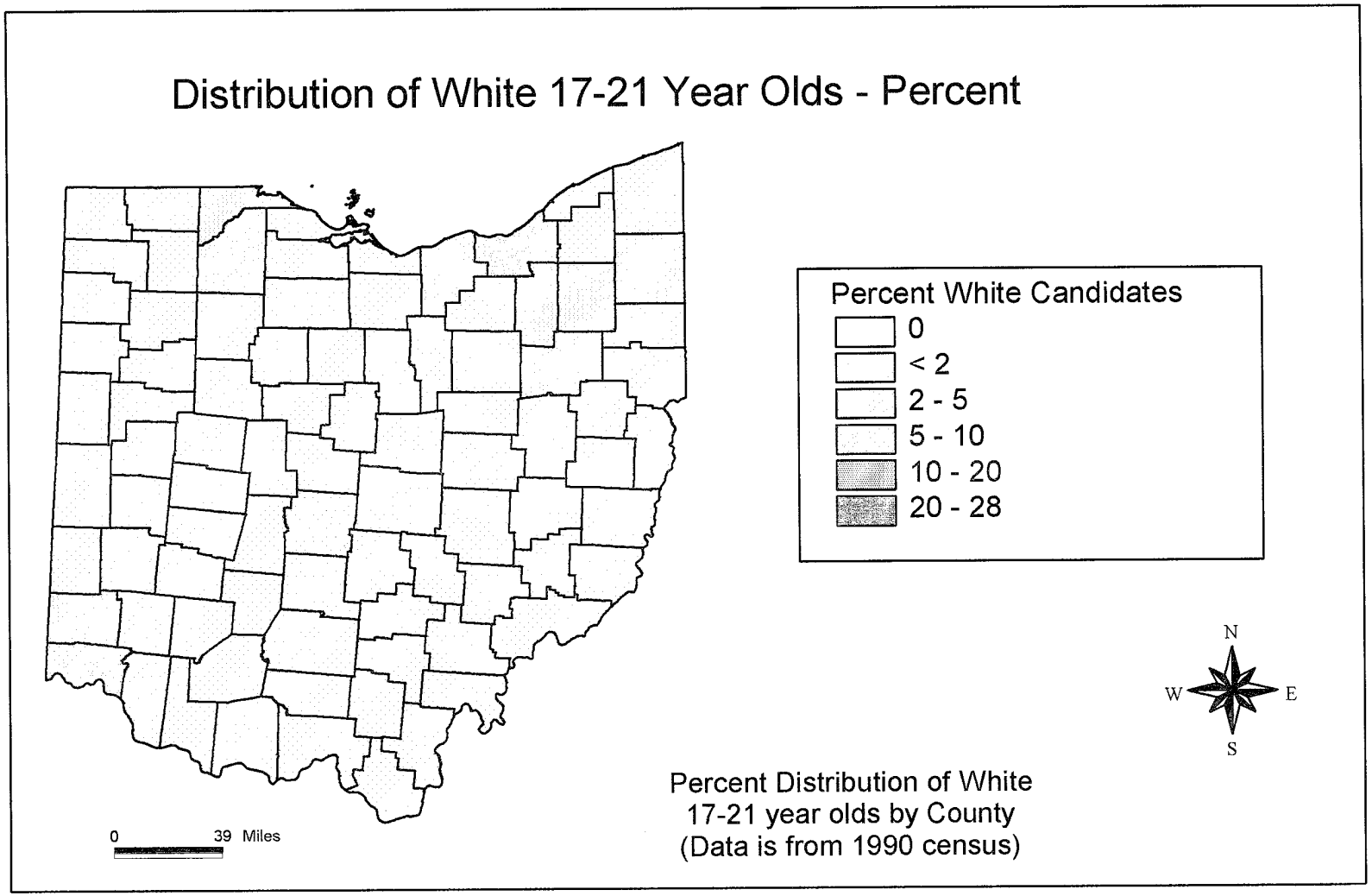


Figure 17. Percent Distribution of White 17-21 Year Olds by County

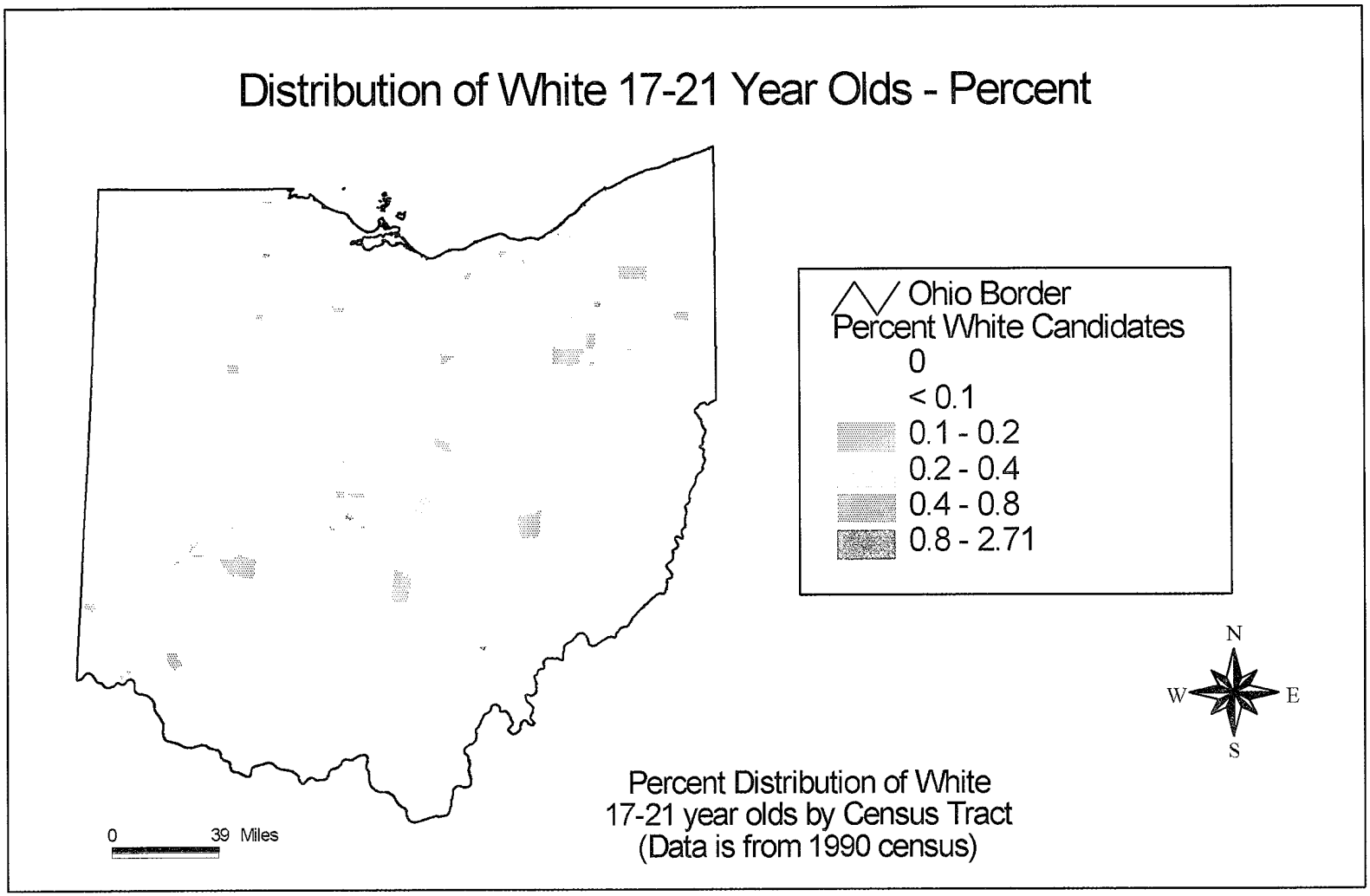


Figure 18. Percent Distribution of White 17-21 Year Olds by Census Tract

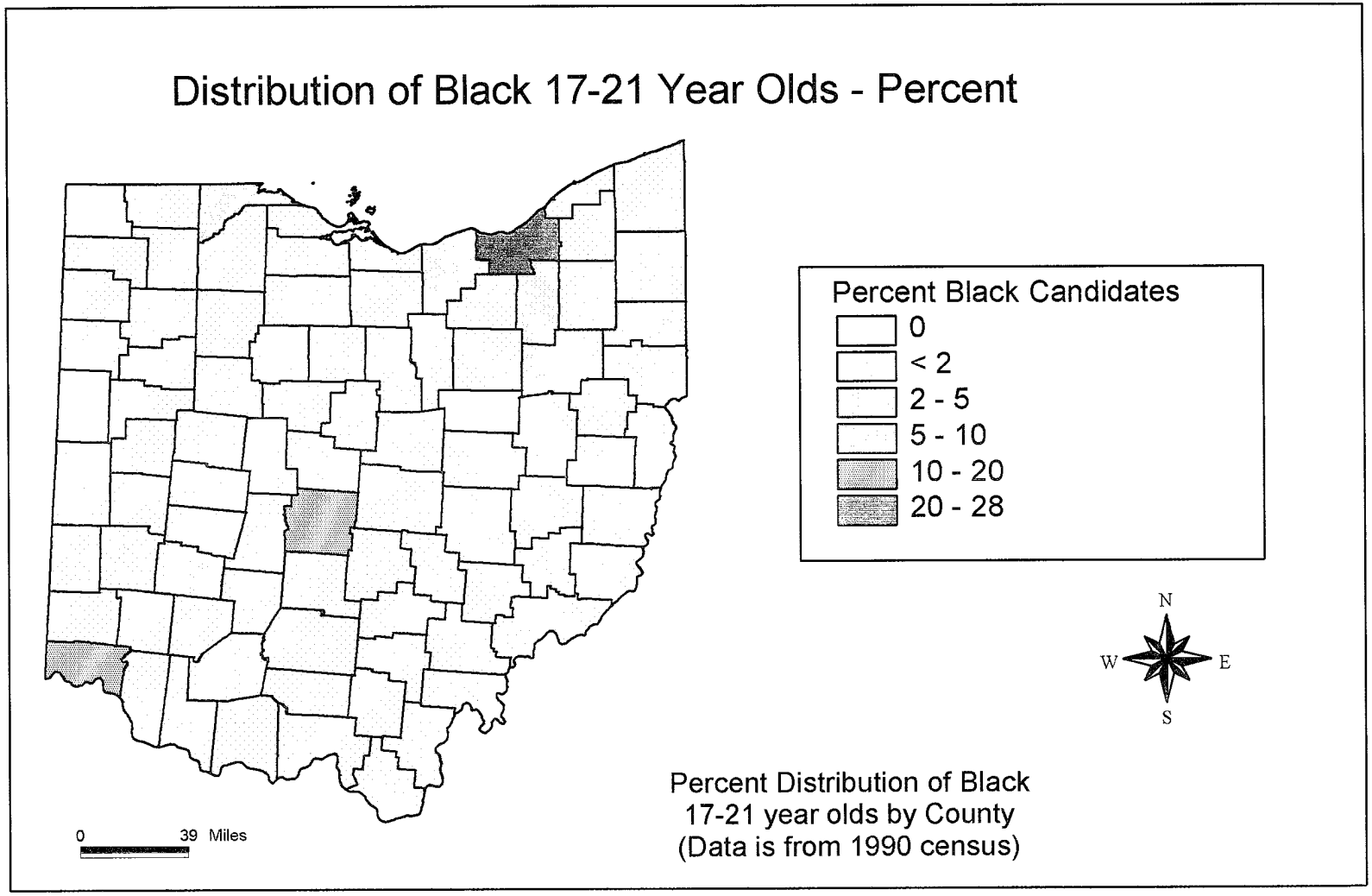


Figure 19. Percent Distribution of Black 17-21 Year Olds by County

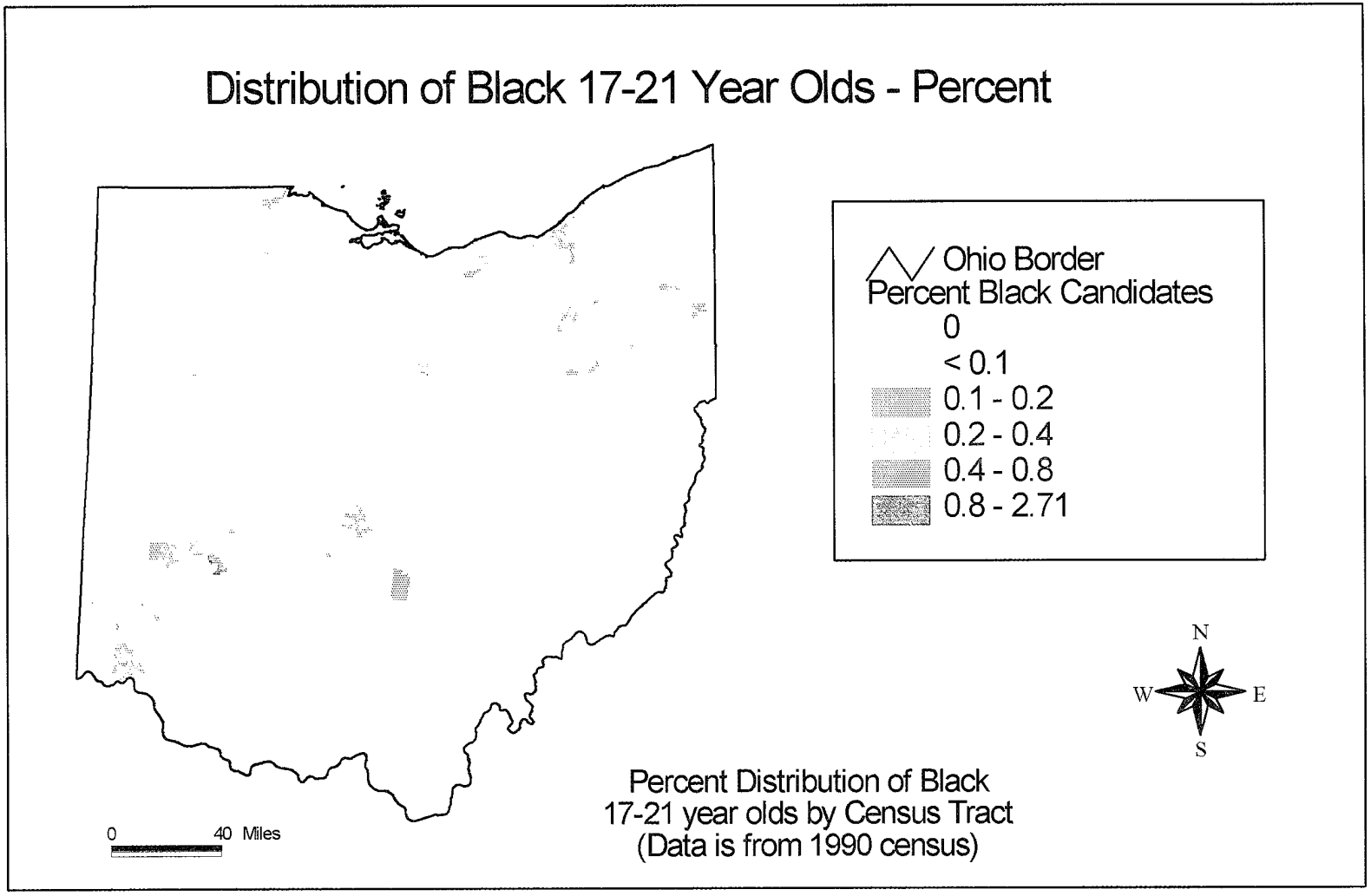


Figure 20. Percent Distribution of Black 17-21 Year Olds by Census Tract

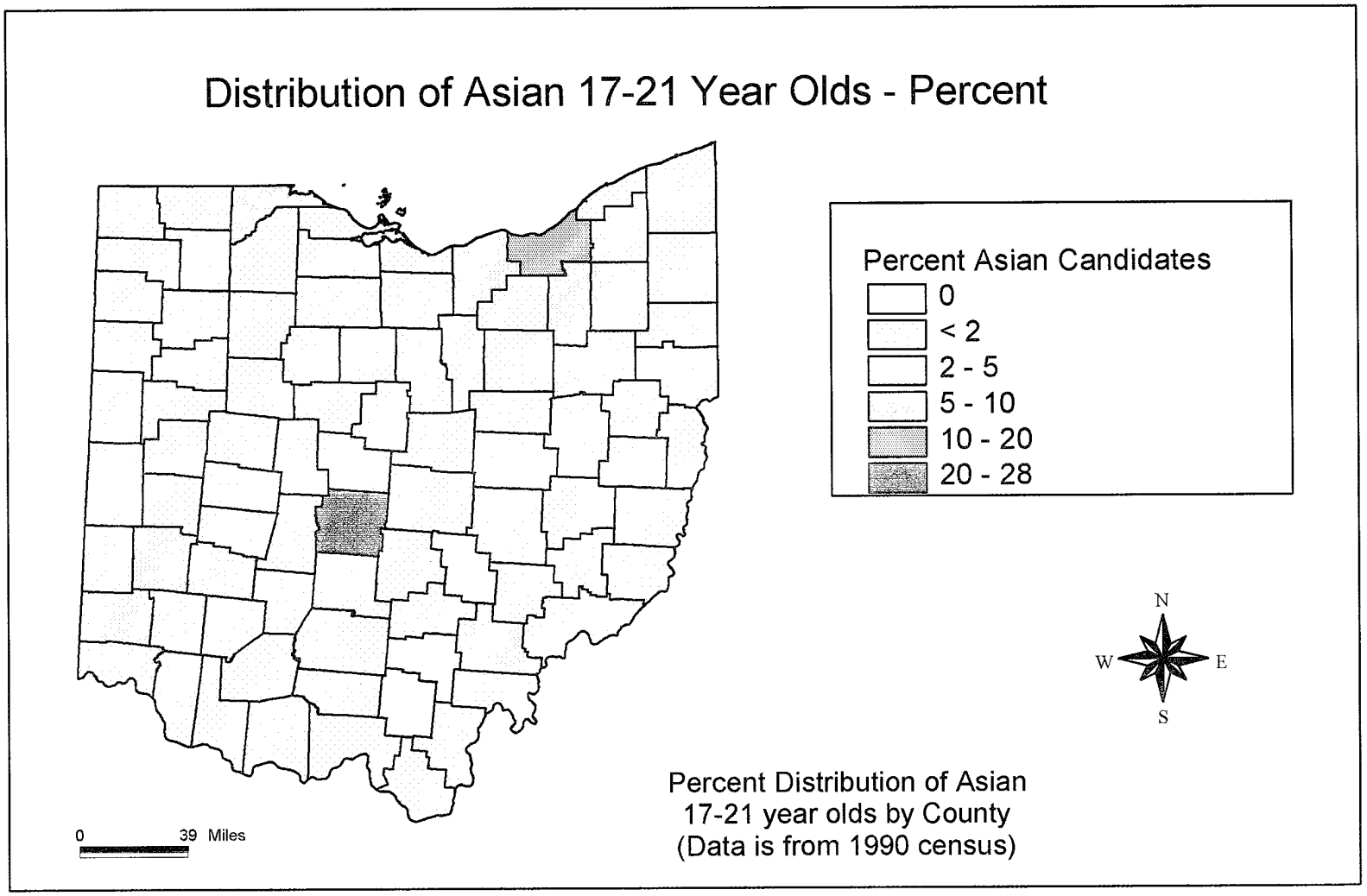


Figure 21. Percent Distribution of Asian 17-21 Year Olds by County

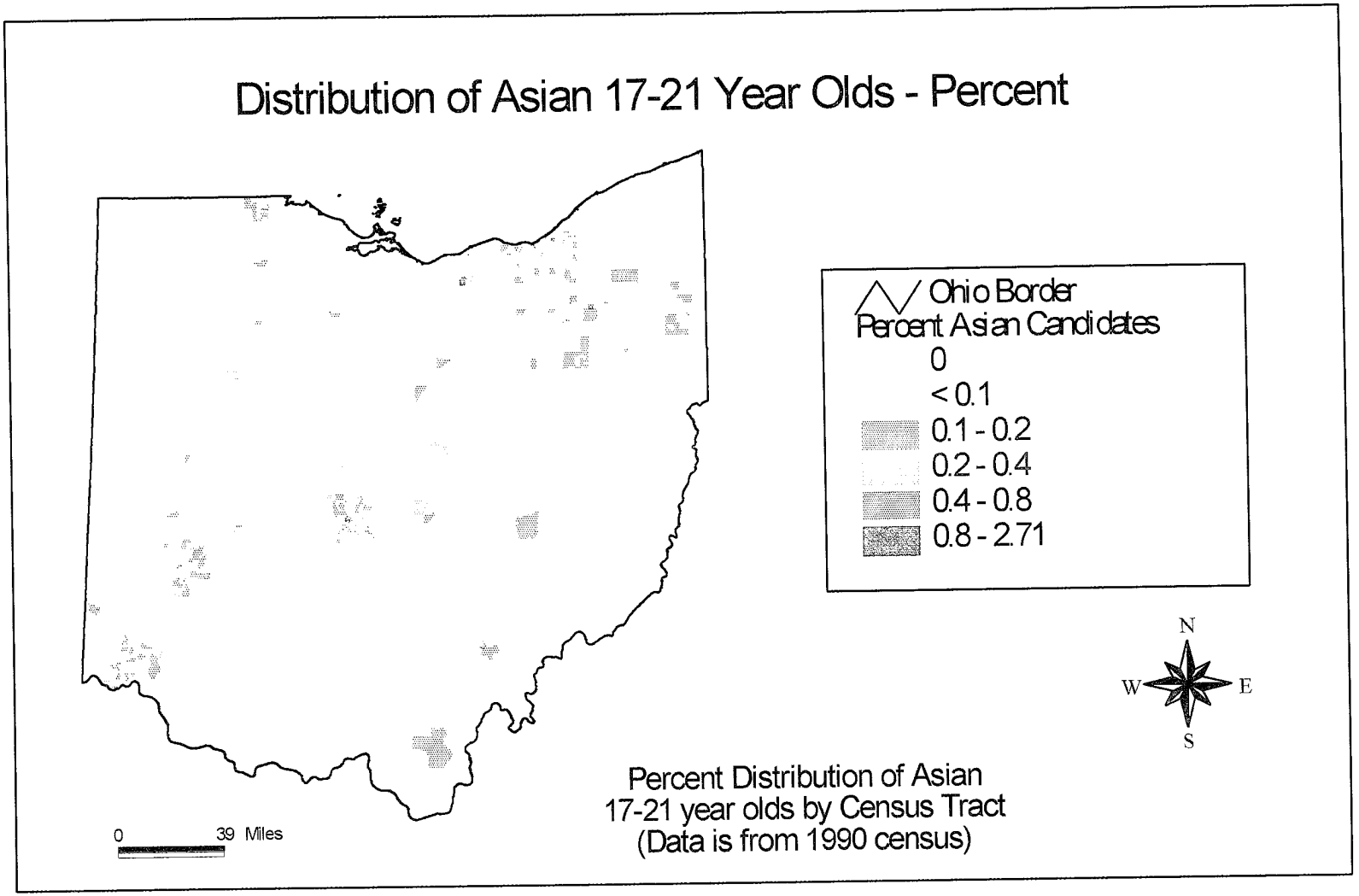


Figure 22. Percent Distribution of Asian 17-21 Year Olds by Census Tract

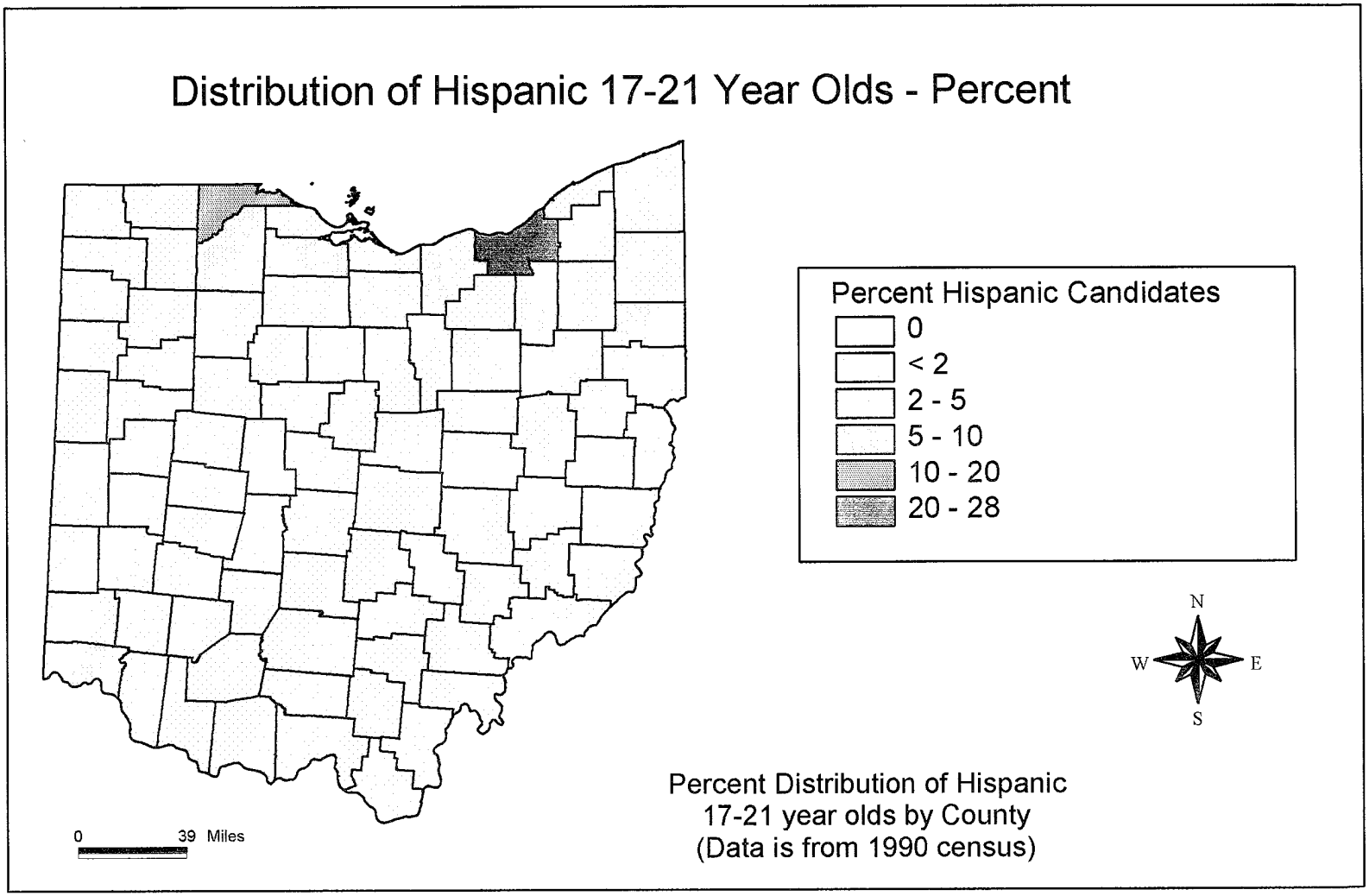


Figure 23. Percent Distribution of Hispanic 17-21 Year Olds by County

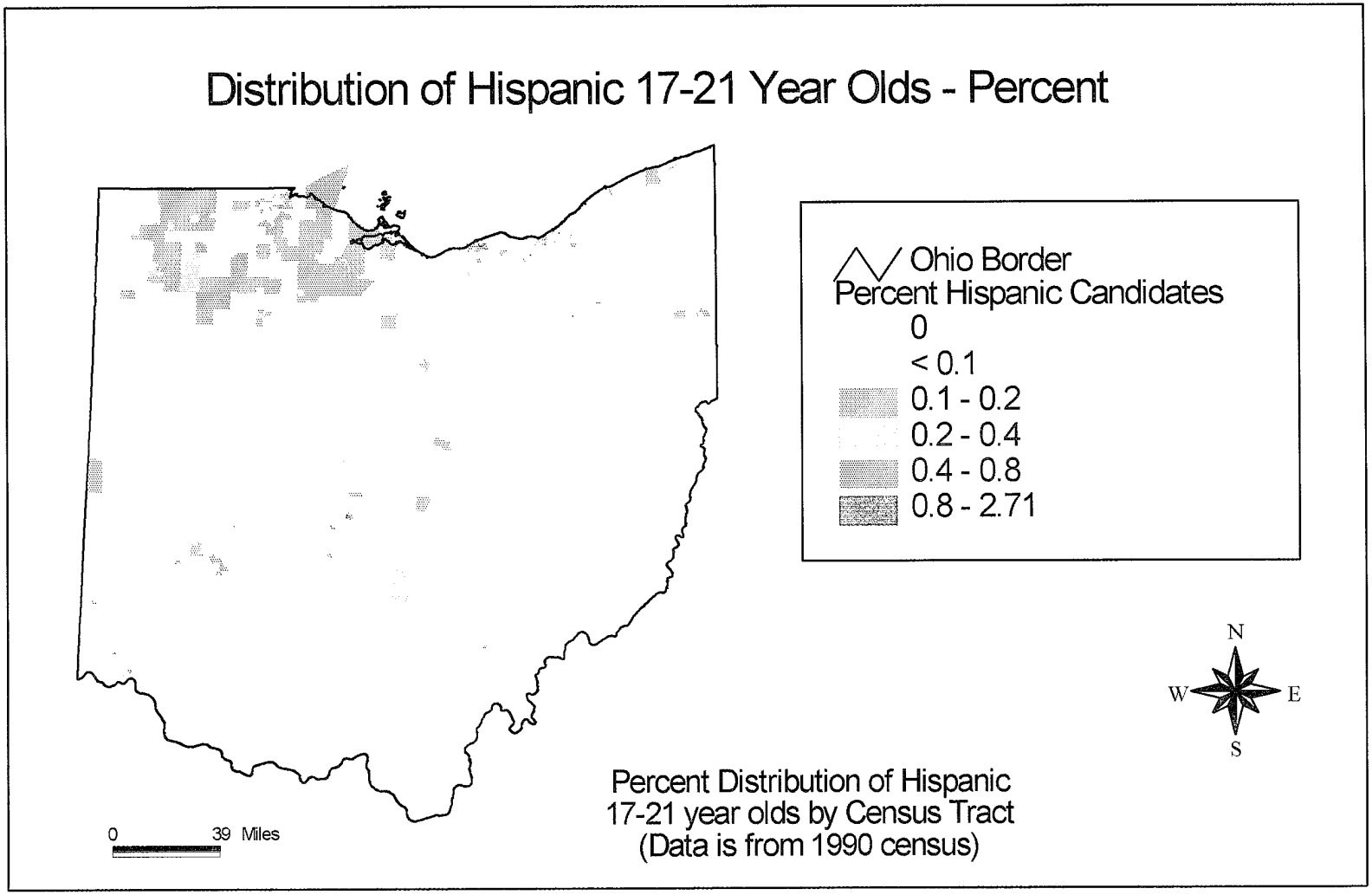


Figure 24. Percent Distribution of Hispanic 17-21 Year Olds by Census Tract

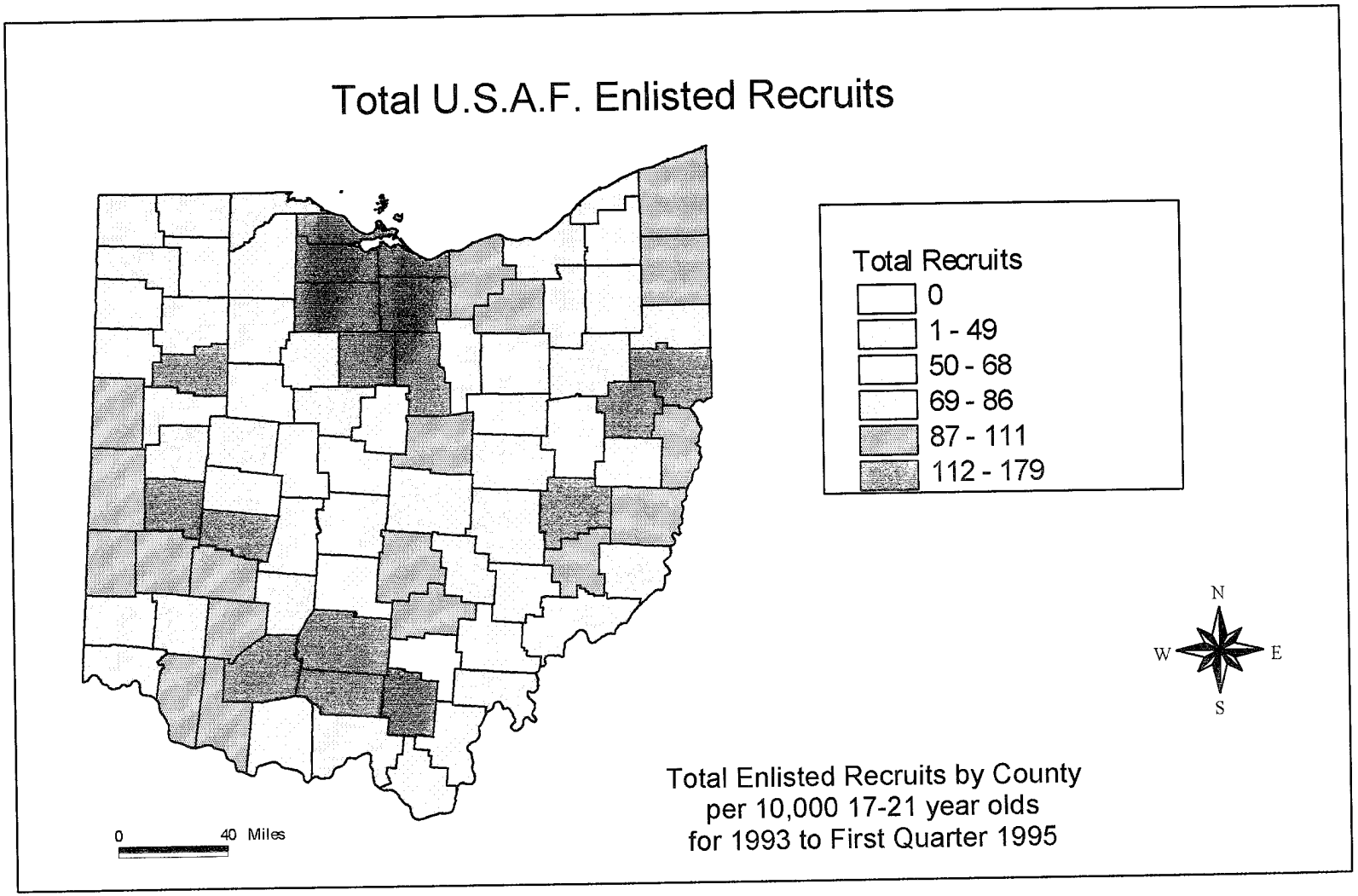


Figure 25. Total USAF Enlisted Recruits by County

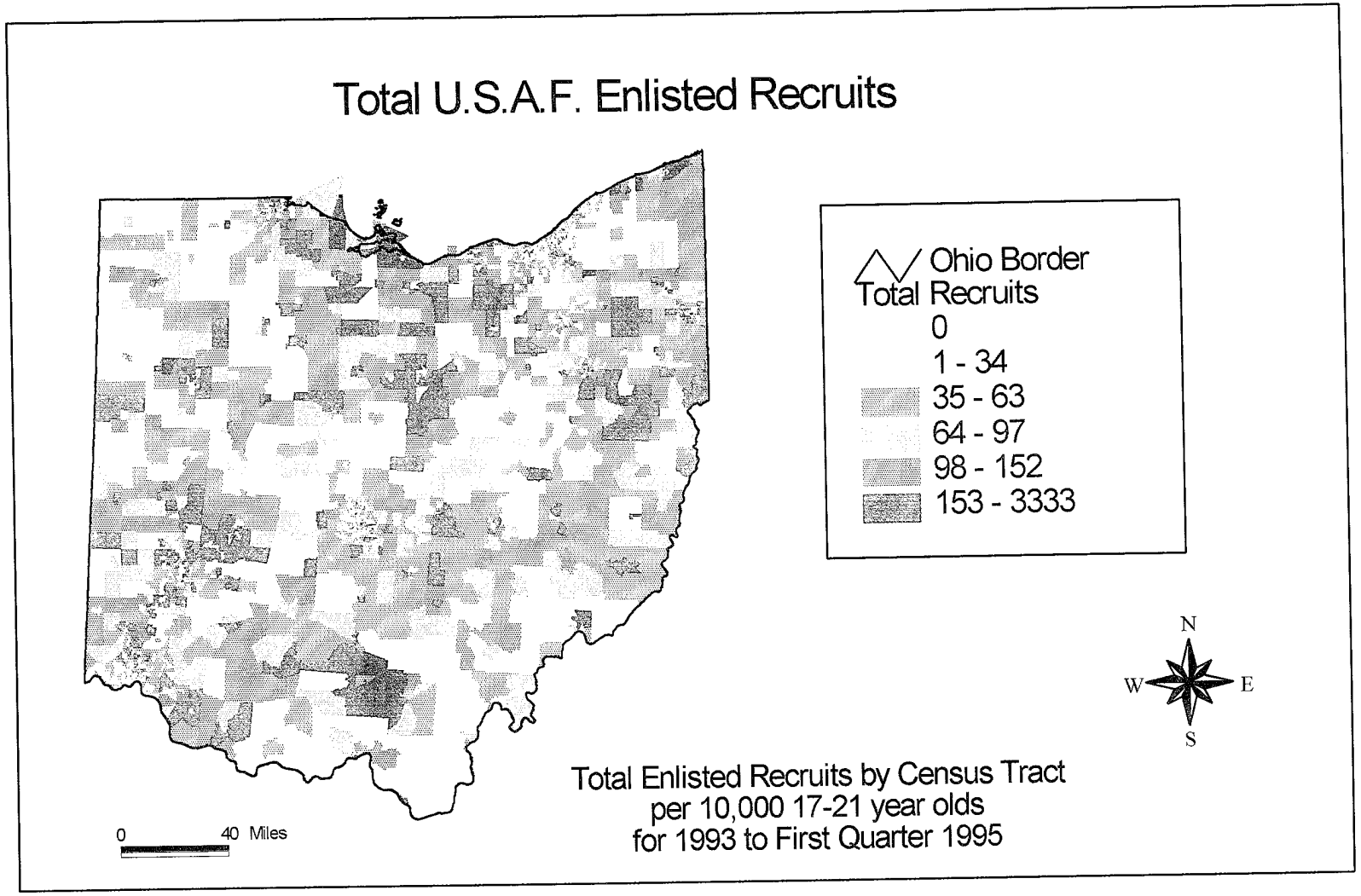


Figure 26. Total USAF Enlisted Recruits by Census Tract

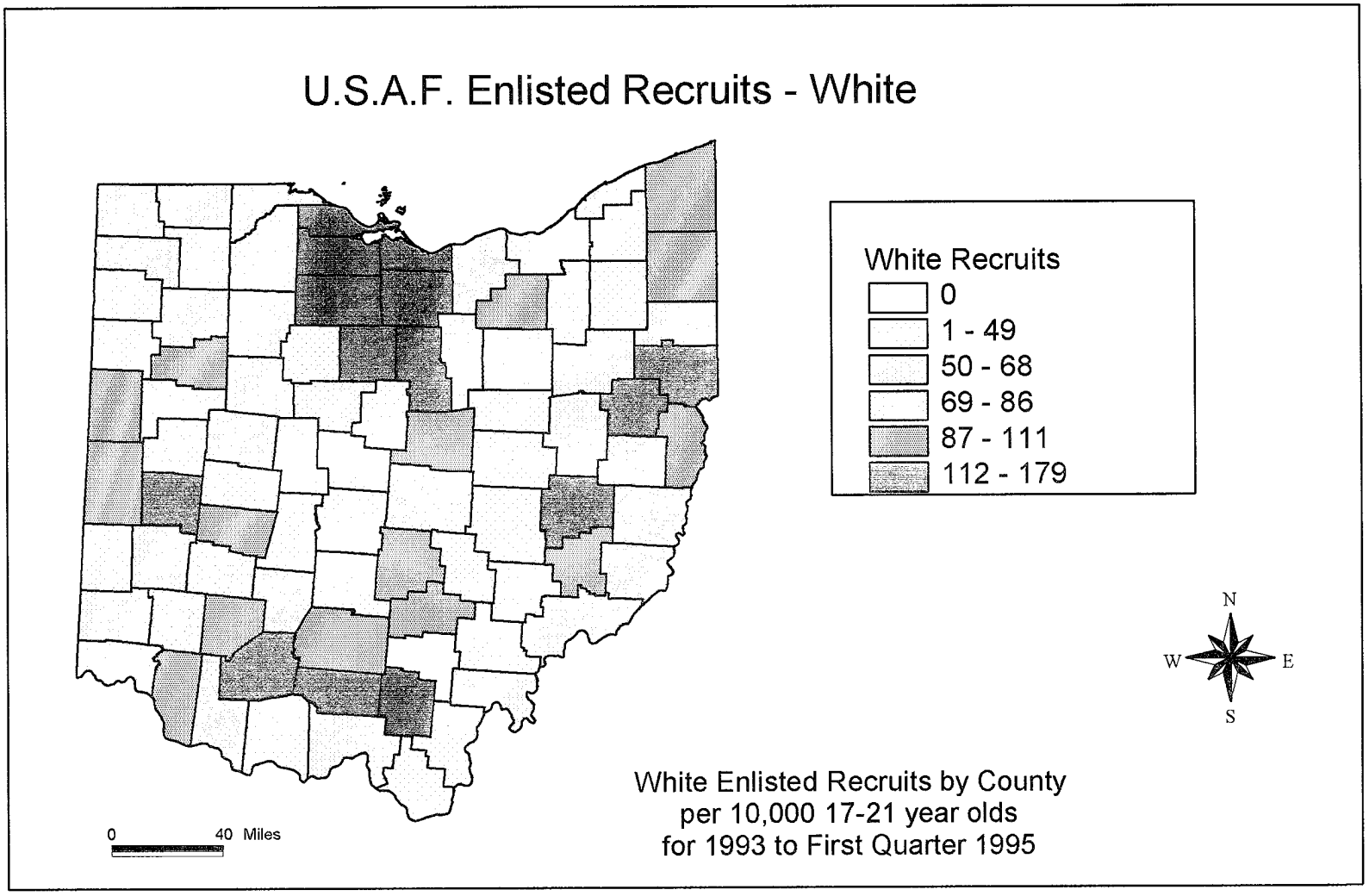


Figure 27. White USAF Enlisted Recruits by County

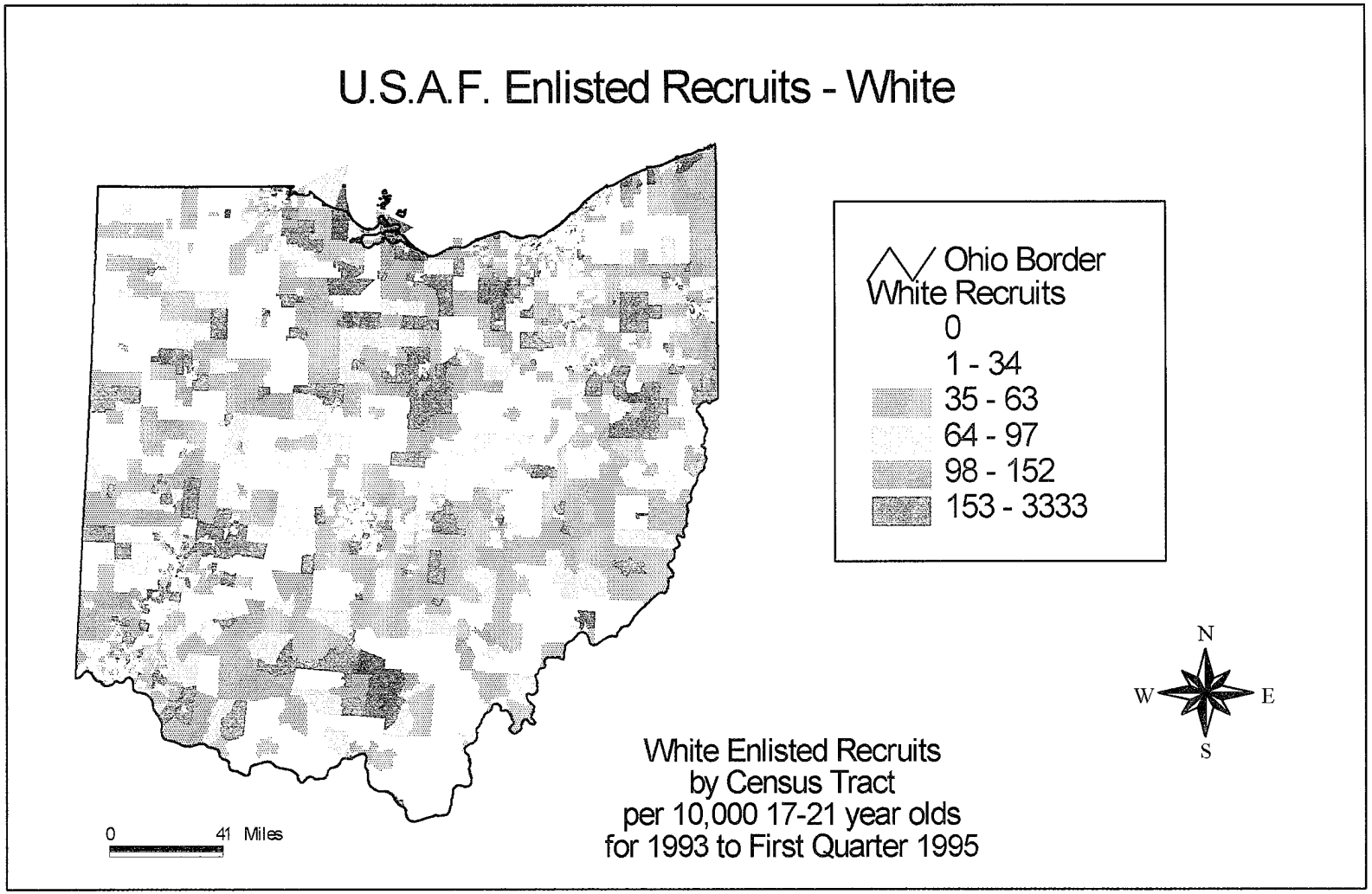


Figure 28. White USAF Enlisted Recruits by Census Tract

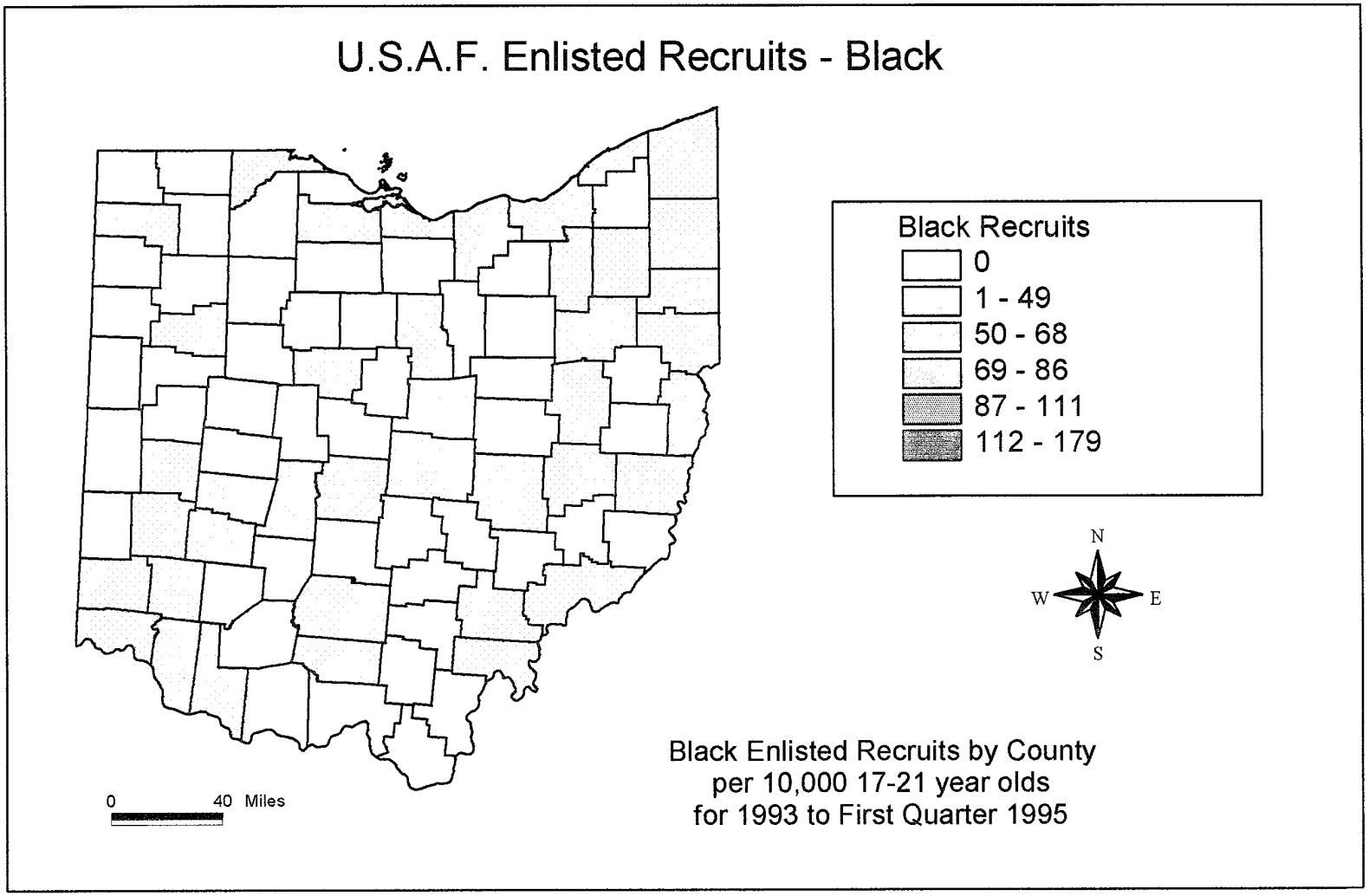


Figure 29. Black USAF Enlisted Recruits by County

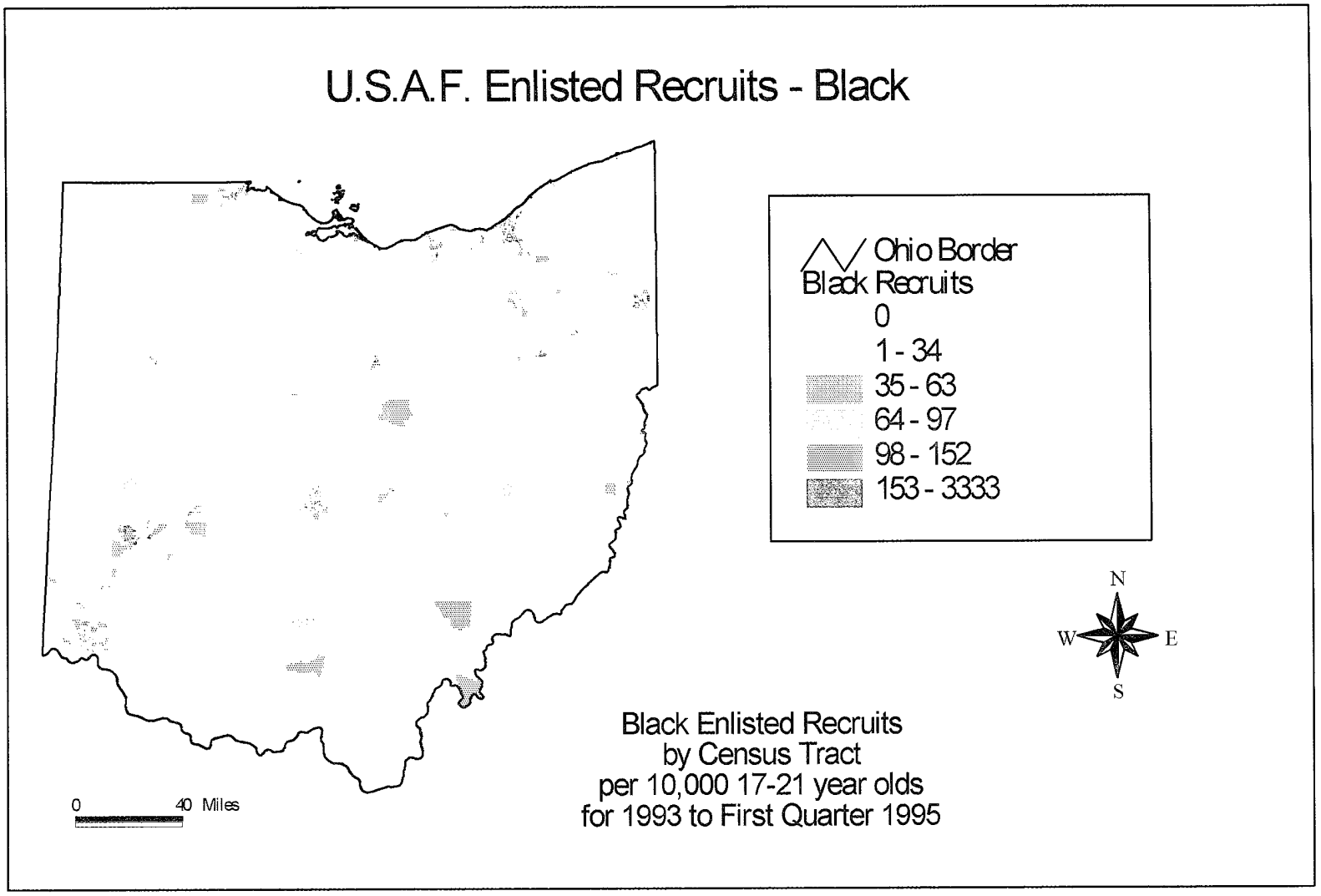


Figure 30. Black USAF Enlisted Recruits by Census Tract

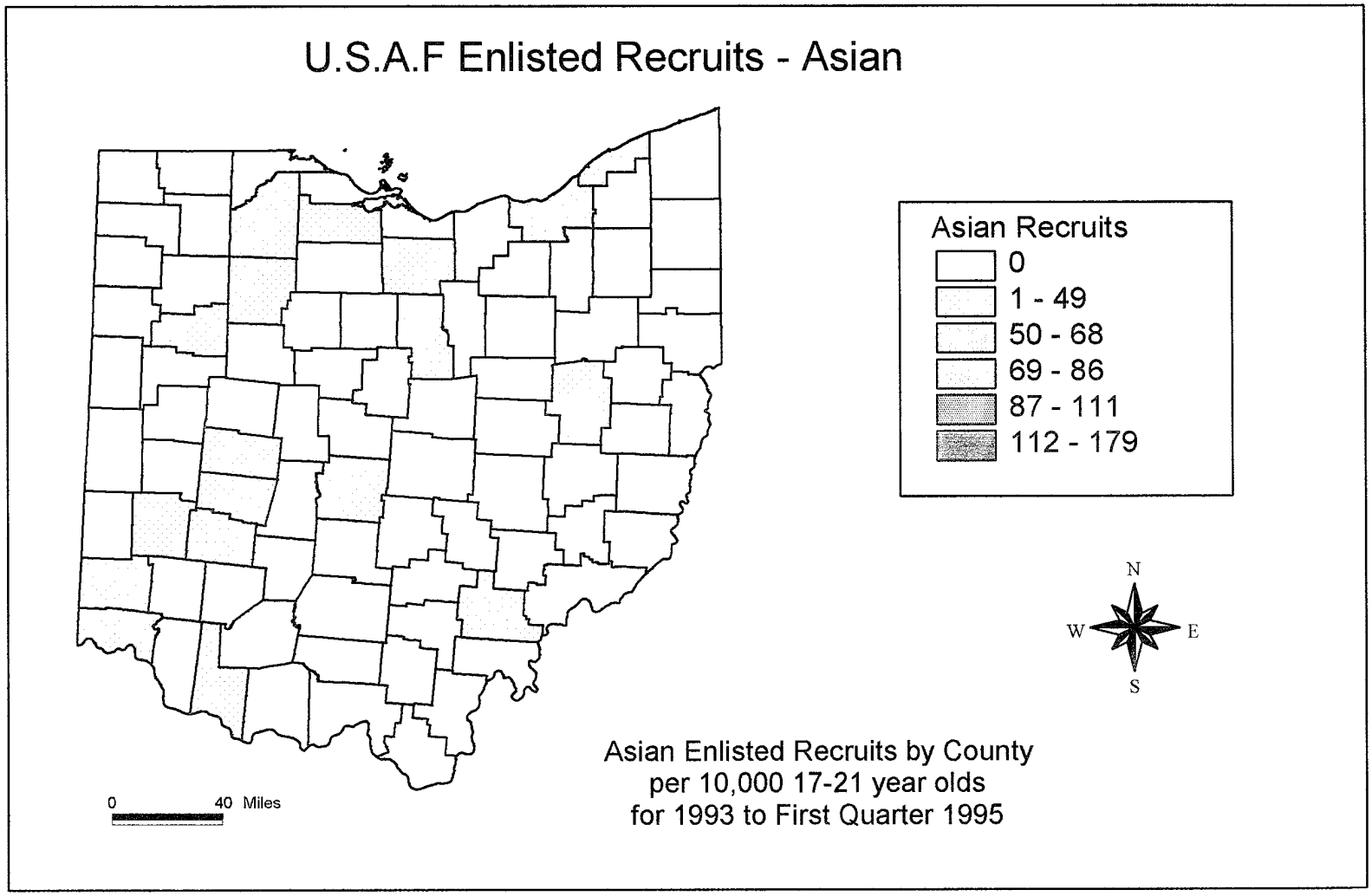


Figure 31. Asian USAF Enlisted Recruits by County

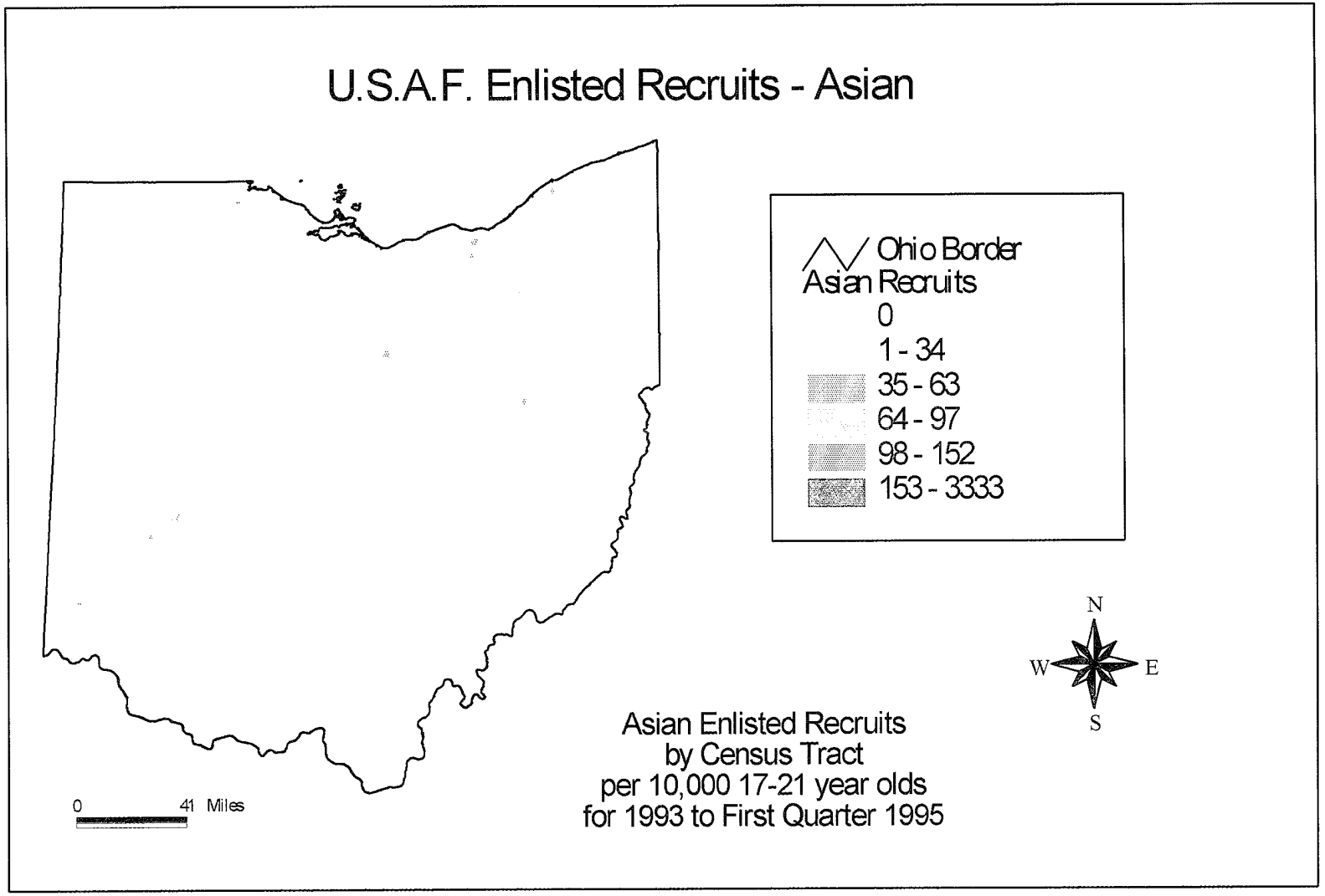


Figure 32. Asian USAF Enlisted Recruits by Census Tract

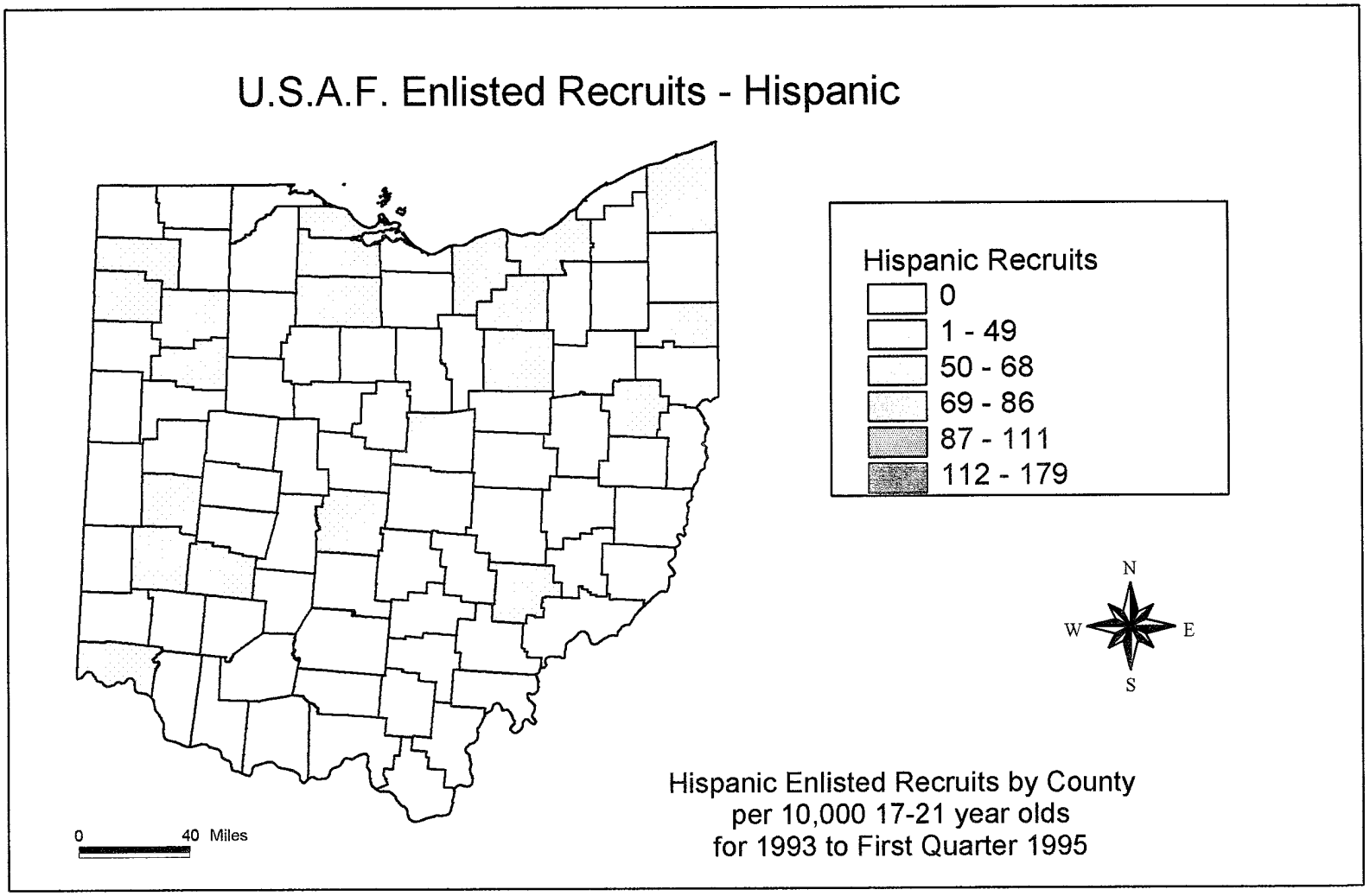


Figure 33. Hispanic USAF Enlisted Recruits by County

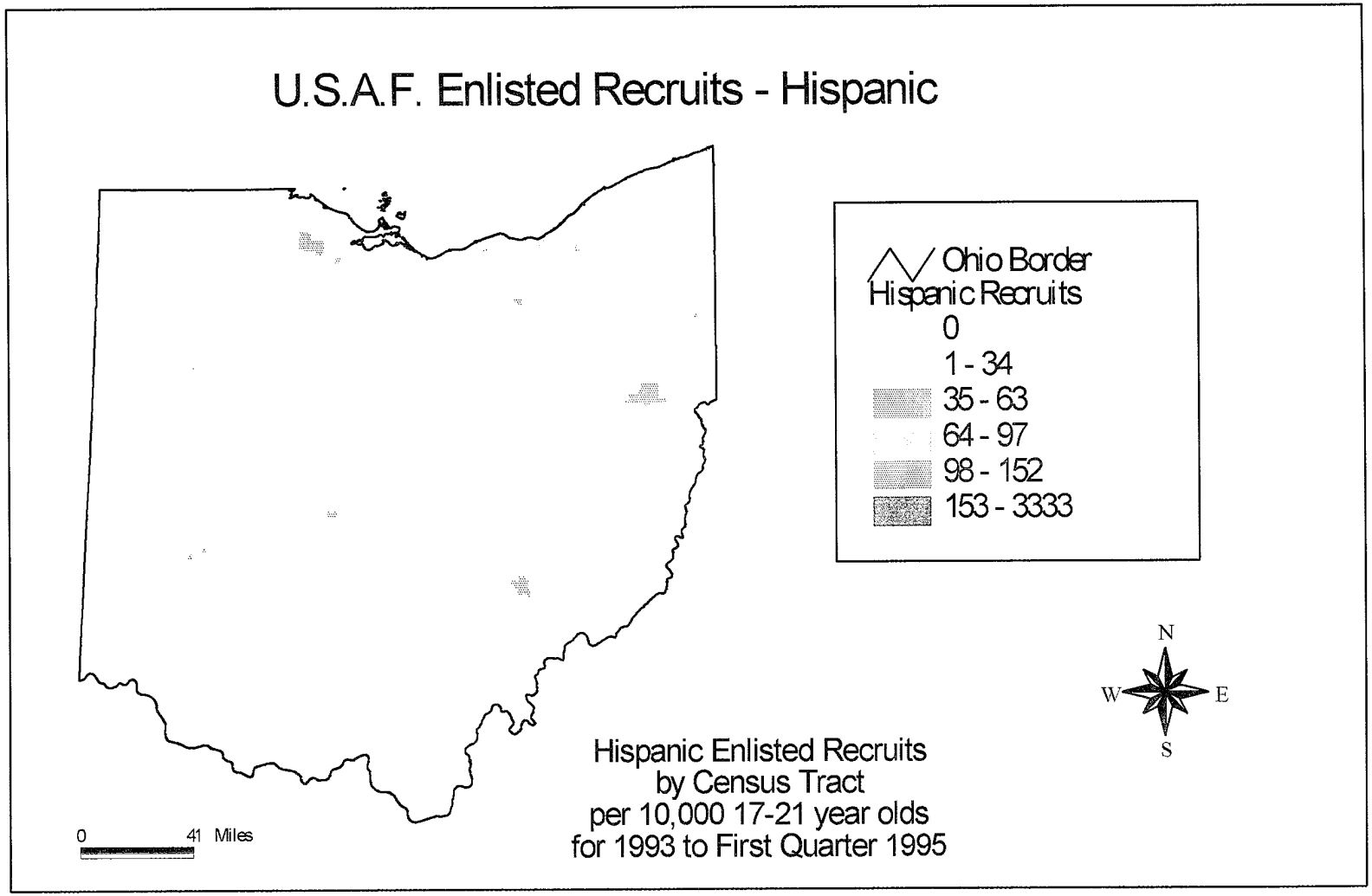


Figure 34. Hispanic USAF Enlisted Recruits by Census Tract

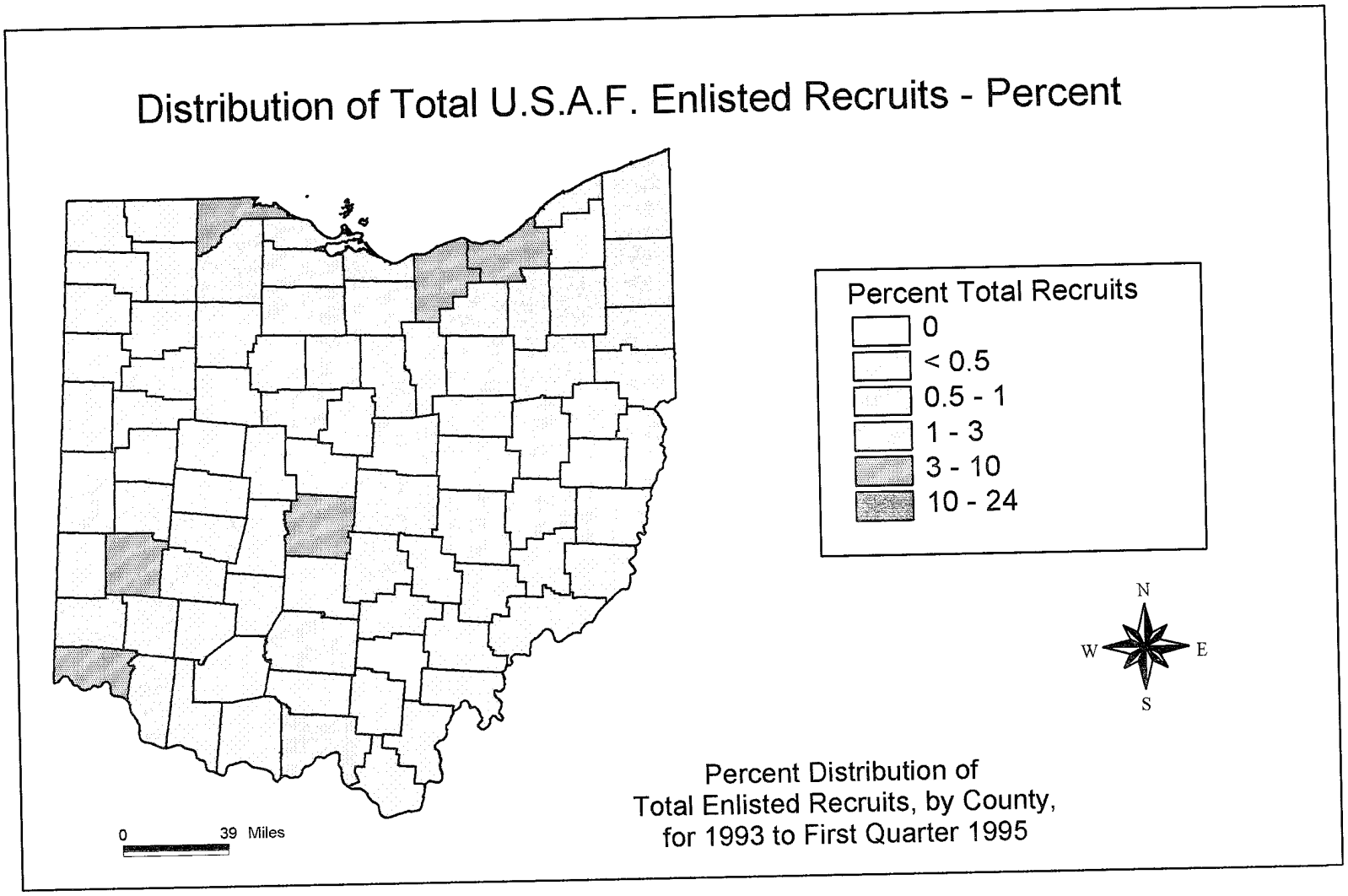


Figure 35. Percent Distribution of Total USAF Enlisted Recruits by County

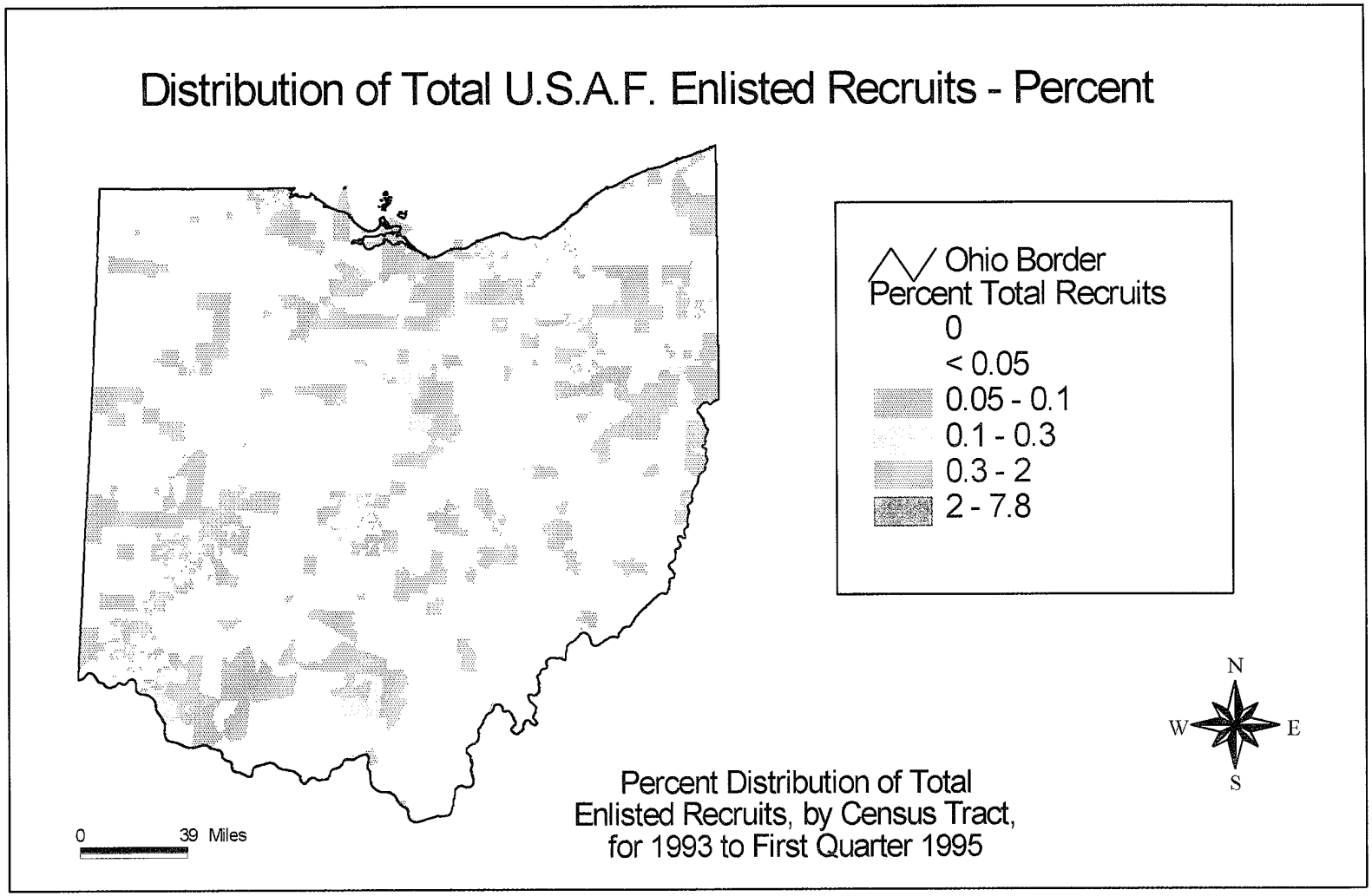


Figure 36. Percent Distribution of Total USAF Enlisted Recruits by Census Tract

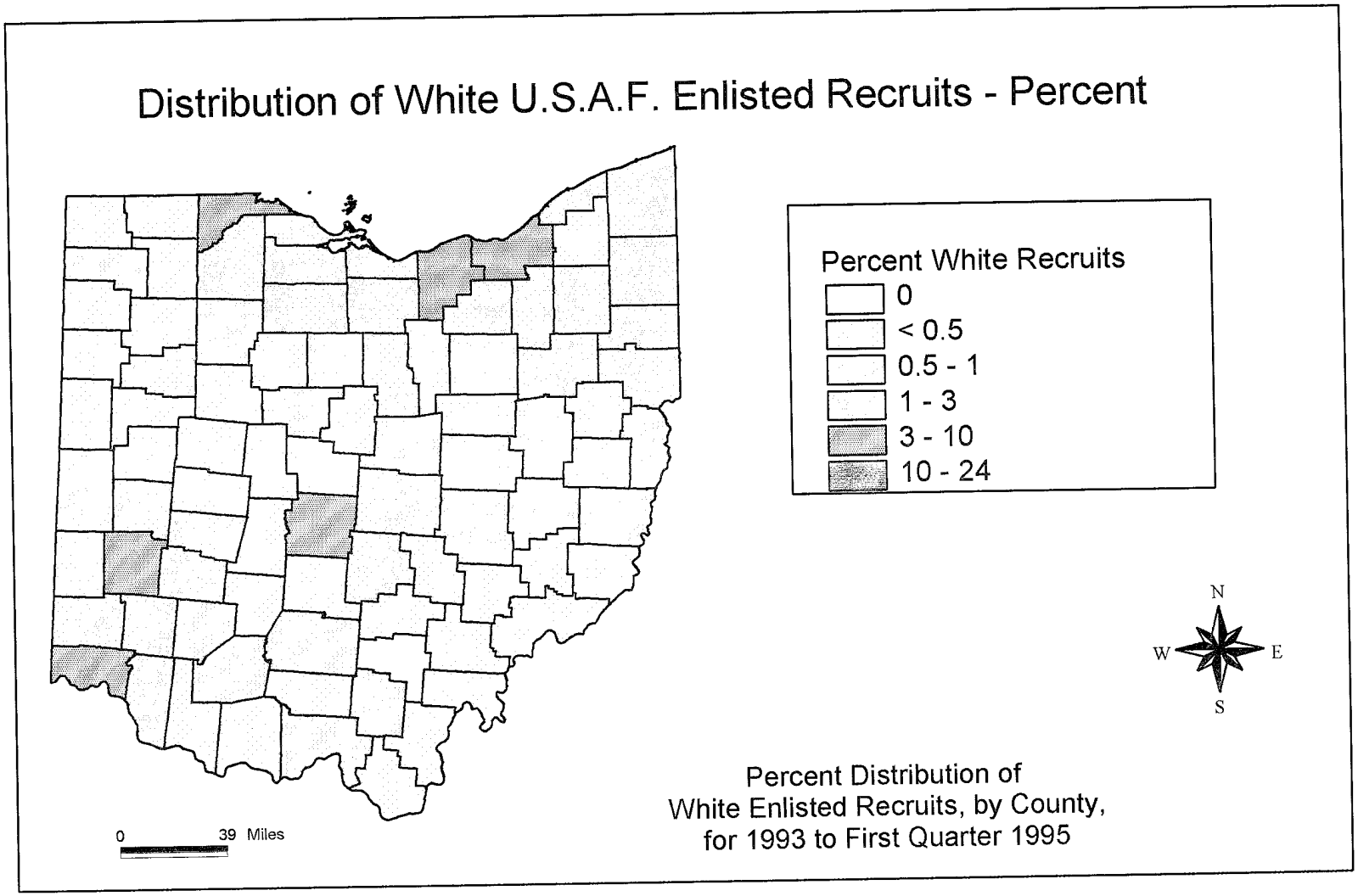


Figure 37. Percent Distribution of White USAF Enlisted Recruits by County

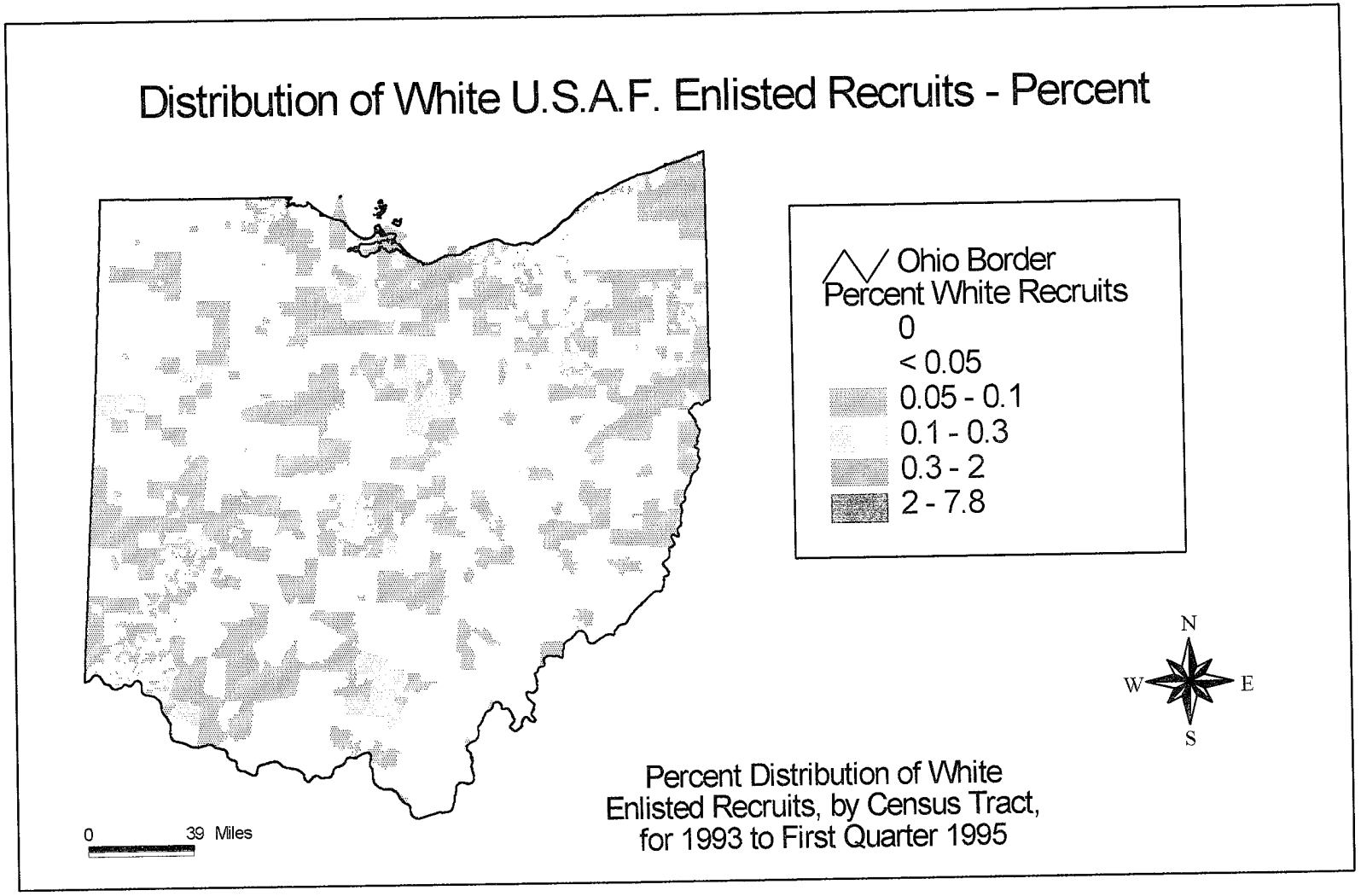


Figure 38. Percent Distribution of White USAF Enlisted Recruits by Census Tract

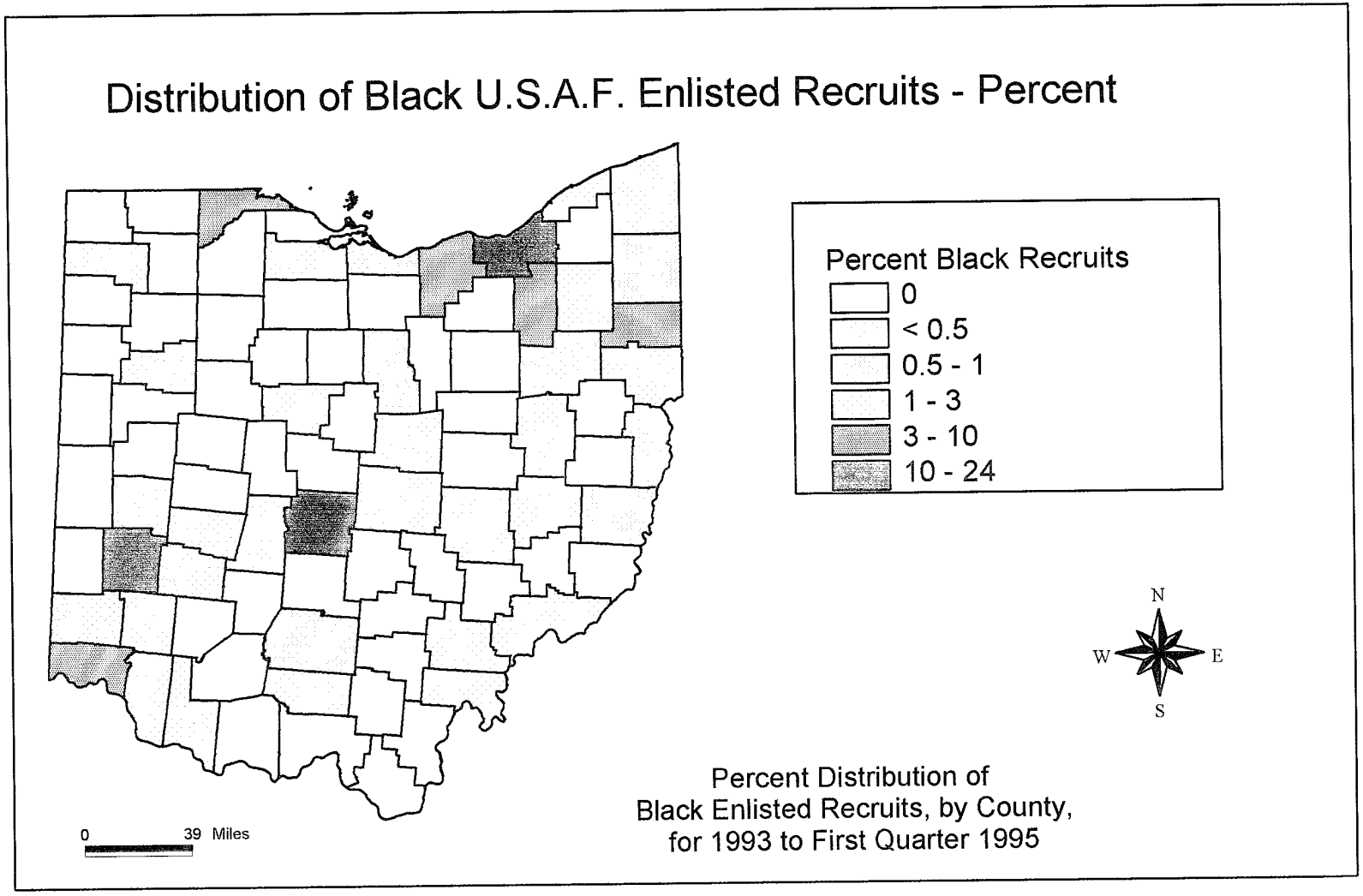


Figure 39. Percent Distribution of Black USAF Enlisted Recruits by County

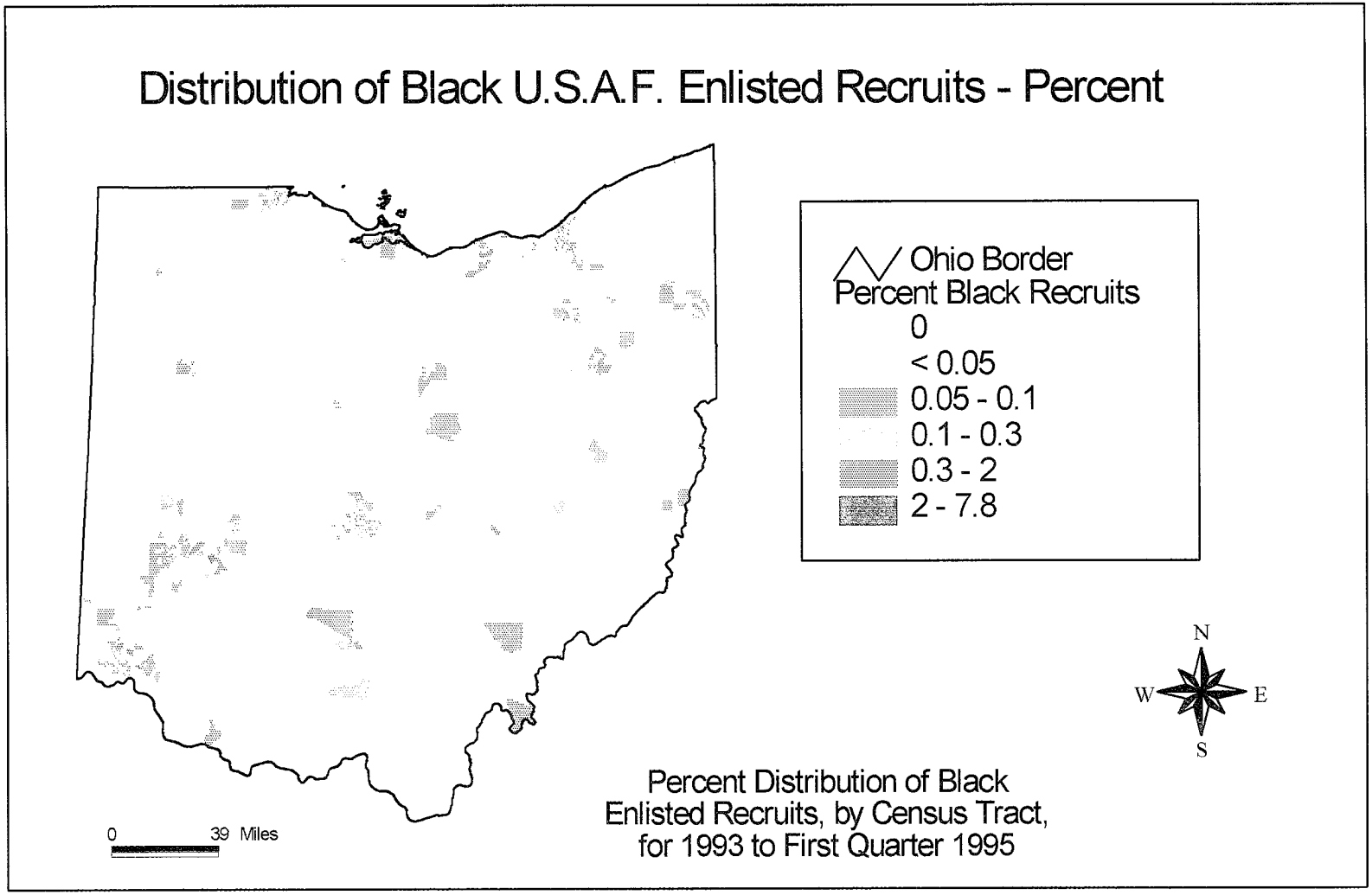


Figure 40. Percent Distribution of Black USAF Enlisted Recruits by Census Tract

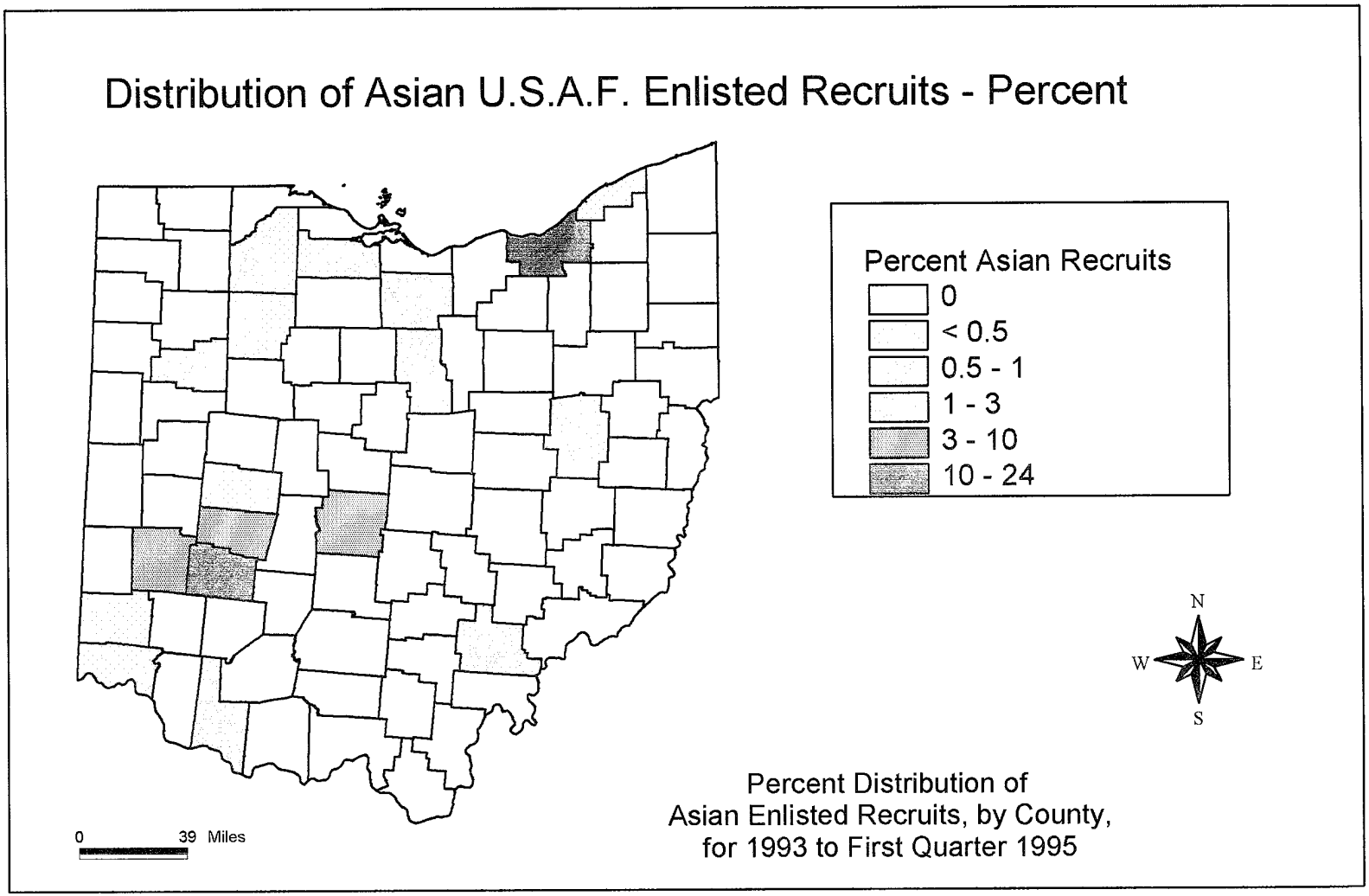


Figure 41. Percent Distribution of Asian USAF Enlisted Recruits by County

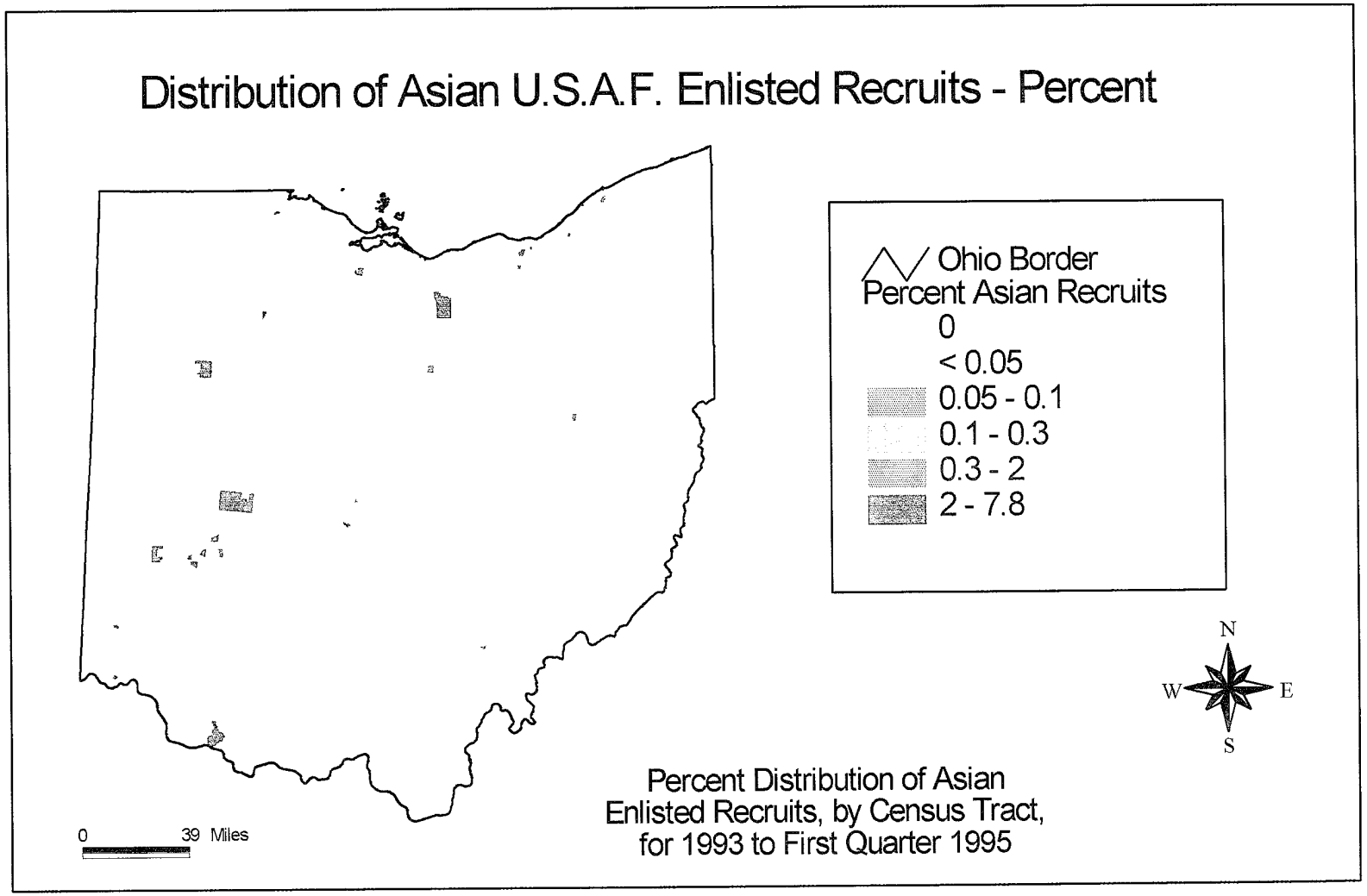


Figure 42. Percent Distribution of Asian USAF Enlisted Recruits by Census Tract

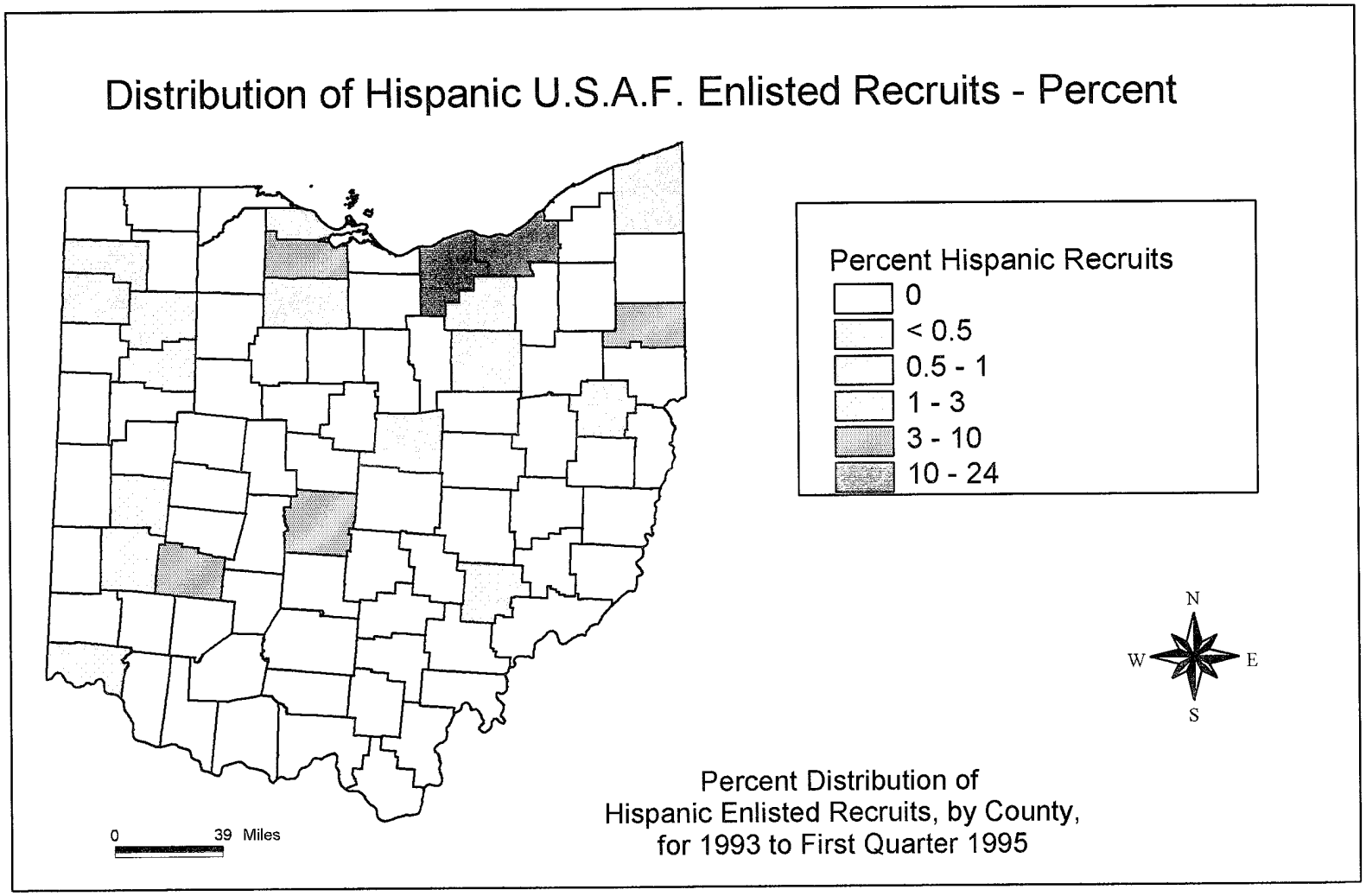


Figure 43. Percent Distribution of Hispanic USAF Enlisted Recruits by County

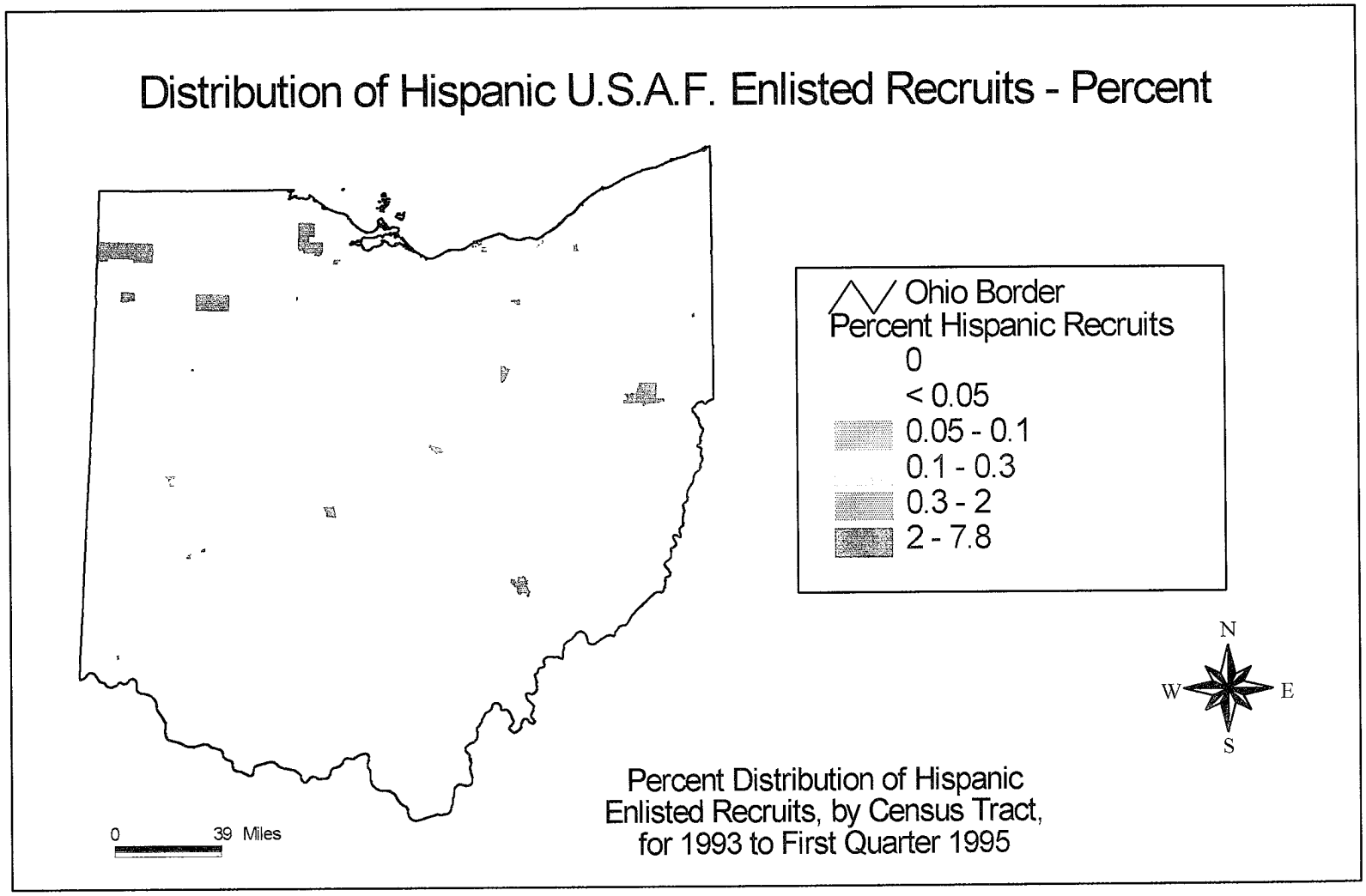


Figure 44. Percent Distribution of Hispanic USAF Enlisted Recruits by Census Tract

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